SILOS

FOR

PRESERVING BRITISH FODDER CROPS

STORED

IN A GREEN STATE.

NOTES ON THE ENSILAGE OF GRASSES, CLOVERS, VETCHES, ETC.

Compiled and Annotated

BY

THE SUB-EDITOR OF "THE FIELD."

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PREFACE.

The second edition of this book was intended to be issued early in the Spring; and the compiler would gladly have carried this intention into effect. Unfortunately, however, he was prevented by illness from making progress with the work, and its publication has in consequence been considerably delayed; but the delay has not proved an unmitigated evil, as it has enabled information to be added on several points which otherwise could not have been included. Mr. Jenkins's excellent report in the "Journal of the Royal Agricultural Society," and the chemical analyses contained in the same volume, although not quoted at any length, have afforded facts which called for comment, and which could ill be spared from the chapter on the feeding value of silage. The same may be said of the South Kensington lecture of Mr. Woods, the tables of feeding experiments at St. Albans by Sir John Lawes, and various other matters.

An endeavour has been made in the present edition to improve upon its predecessor, and to render the book of greater interest and utility, by illustrating the various points of ensilage practice by results obtained in recent experiments. Especially has it been thought desirable, in Chapters IX. and X., to impress upon beginners the lessons to be learned from scientific investigators, by showing the nature of losses which may ensue from slovenly modes of operation, although the provender remaining may itself be good; also the wide difference in value of samples of silage made from different

crops, or from similar crops under varying conditions of moisture, &c.; and likewise to trace the cause of the conflicting results reported as to the effect of silage on dairy produce and on the condition of the animals fed upon it.

The consequence has been that the volume has been much expanded, and a number of supplementary pages have had to be interpolated (pp. 160A to 160P) because, the last half of the book having been printed first, in order to afford an opportunity for direct reference to the numerous experiments commented on, the allotted space was considerably overrun by the aftergrowth of material, notwithstanding the omission of the greater portion of the contents of the previous edition, so far as they related to experiences abroad. Altogether the volume has become nearly twice the thickness of that of last year, despite the great amount of condensation the reports of experiments have undergone; nearly three-fourths of the matter in the present issue was not included in the first edition; and the amount of correspondence and extracts which have perforce been laid aside, would have sufficed to make a second volume of equal bulk.

One result of this expansion has been to make it obvious that this book is much too voluminous to meet the requirements of persons who wish to gain a general knowledge of the process without going deeply into details; and, as some landed proprietors have expressed a wish to distribute among their tenantry a small publication affording such particulars, a selection has been made from the pages of this work and issued as a cheap pamphlet under the title of "Short Notes on Silo Experiments and Practice."

Field Office, June, 1884.

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ILLUSTRATIONS.

BOOKS ON ENSILAGE.

The following is a list of books on ensilage. Those marked † we have not seen, but take the particulars from Dr. Thurber's book :

"Manuel de la Cultnre et de l'Ensilage des Maïs et autres fourrages verts." Par Auguste Goffart. 4th edition. Paris: G. Masson, 120, Boulevard Saint Germain. 1883.

† M. Goffart's previous edition was translated by Mr. J. B. Brown, and published at New York in 1879.

"Le Maïs et les autres fourrages verts, Culture et Ensilage." Par Ed. Lecouteux. 2nd edition. Paris: Librairie Agricole, 26, Rue Jacob. 1883.

"The Book of Ensilage; or, the New Dispensation for Farmers." By John M. Bailey. New York: Orange Judd Company, 751, Broadway. 1881.

† "Ensilage of Green Forage Crops in Silos." By H. R. Stevens, Echo Dale Farm, Dover, Massachusetts. Published by the author.

"Silos and Ensilage: the Preservation of Fodder Corn and other Green Fodder Crops." By Dr. George Thurber. New York: Orange Jndd Company, 751, Broadway. 1881.

"Silos and Ensilage. A Record of Practical Tests in several States and Canada." Special Report No. 48; Department of Agriculture. Washington: Government Printing Office. 1882.

"Ensilage: A System for the Preservation in Pits of Forage Plants and Grasses, independent of Weather." By Thos. Christy, F.L.S. London: Christy and Co., 155, Fenchurch-street. 1883.

"Ensilage in America: its Prospects in English Agriculture." By James E. Thorold Rogers, M.P. London: W. Swan Sonnenschein and Co., Paternoster-row. 1883.

"Ensilage: its Origin, History, and Practice; with Experimental Trials and Results, and illustrated by Plans," &c. By Henry Woods. Norwich: Stevenson and Co. London: W. Ridgway, 169, Piccadilly. 1883.

"Ensilage: its Influence upon British Agriculture." By Henry Woods. London: Hamilton, Adams, and Co., 32, Paternoster-row. 1884.

"Ensilage: how to make and how to use it; showing its practical value." By Robert Foulis. William Blackwood and Sons, Edinbnrgh and London. 1884.

"The Journal of the Royal Agricultural Society of England." Vol. XX., Part I. April 1884. London: John Murray, Albemarle-street.

A shorter article appears in the "Journal of the Bath and West of England Society;" and articles in other publications are too numerous to particularise.

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INTRODUCTORY.

BAD seasons and severe competition have made it imperative on the British farmer to look to something more profitable than corn crops as a means of existence. The most fruitful source of profit seems now to lie in the feeding of live stock of some description or other; for, whereas wheat and other cereals are kept down to exceedingly low prices by the enormous supplies forthcoming from countries where they can be grown at considerably less cost than in these islands, the demand for butchers' meat and for dairy produce increases faster than the supply, and prices are enhanced accordingly, despite the efforts of foreigners to send us dead carcases and live stock, butter, cheese, and other produce.

How long this state of things will last it is difficult to say; but meanwhile it behoves the agriculturist to make the most of his opportunities, and to turn his resources to the best account, so as to be able to hold his own when the pinch comes. If he can, by recourse to processes that are new to him, feed his stock more cheaply than heretofore, and store his fodder crops in safety instead of leaving them to rot in the fields under rainy skies, he may be able to withstand competition should it become even more sharp than at present.

The storage of green fodder in pits is a subject to which the attention of the agricultural world has been directed, from time to time, for many years past; but with very little effect. The German practice was described in the "Transac-

tions of the Highland and Agricultural Society" more than forty years ago; but it is not surprising that this fact should be almost unknown to people of the present generation, although the article was copied into Stephens's "Book of the Farm," printed in 1844, and in subsequent editions of that work; as well as in the "Rural Cyclopedia," by the Rev. John M. Wilson, published in 1848, and in the "Farmers' Dictionary of Agriculture," by the same author, issued a few years later. It is more remarkable, however, that so little should be known of what has been said and done within the last few years, and that ensilage should now be generally looked upon as a new invention. In the *Farmer*, in 1870, Mr. T. Schwann wrote on the "sour-fodder" process as carried out in Hungary; and he alluded to it again in the *Field* in 1876, when writing about M. Goffart's doings in France. Professor Wrightson, when reporting on the agriculture of the Austro-Hungarian Empire, in the "Journal of the Royal Agricultural Society of England," in 1874, said that this "sour hay" was well worth the attention of our agriculturists; and he returned to the subject in the *Times* in 1875. The *Agricultural Gazette* published an illustrated description of the process about the same period, besides many more recent contributions; and numerous articles have since appeared in the various agricultural journals of the three divisions of the United Kingdom.

Of late years the subject has been taken up in the agricultural press of America, and with much more effect than in this country. The first silo is said to have been made and filled in 1876 by Mr. Francis Morris, who officiated as president at the Ensilage Congress at New York last year. In the autumn of 1876, also, Mr. C. W. Mills buried in a trench some maize that had been damaged by frost, and he found its condition so good next spring that he used it for feeding his cattle. After this, others tried experiments; and M. Goffart's manual having been translated as a text-book, our American cousins set vigorously to work, and proved the process to be both practicable and profitable. Accounts of the successful results have accordingly been brought back to the Old World, and

some writers on the subject appear to have imagined that the process was an American discovery, and quite a new invention.

A few, but very few, silos were constructed in this country prior to 1883, and these were mostly of small dimensions. The experiments of one English gentleman (Mr. A. J. Scott), whose letter is printed on page 235, commenced eight years since—which is as far back as the earliest silos made in the United States. The great impulse given to the ensilage process in this country dates only from the summer of 1882, when the Vicomte Arthur de Chezelles paid a visit to the Royal Agricultural Show at Reading, and gave to Englishmen some account of his doings. The striking woodcut (at p. 195) of a silo of more than 1000 tons capacity was calculated to impress itself on the mind; the statement that hundreds of acres of clover, tares, lucerne, and artificial grasses were stored therein showed the application of the system to crops ordinarily grown on British farms; and the subsequent visit of Mr. H. Kains-Jackson to the Château de Boulleaume, and his account of the feeding of 130 milch cows, besides bullocks, sheep, and horses, upon this pitted fodder, proved that the question had at length been brought within the range of the practical politics of the farmyard.

Seven lean years have made many British farmers more receptive of new ideas than they were formerly. Numbers are now willing to construct silos, and anxious to know how to set about the work; and those who had any knowledge of the subject have freely given information thereon. But some who have constructed silos have either not had good advice, or, through following notions of their own, have fallen into serious errors; while theorists, on reading about ensilage, at once began to suggest methods for improving or simplifying a process of which they had little experience, or none at all.

It is well for beginners to "hasten slowly;" they should learn to walk before they attempt to run. Many suggested improvements are old methods tried years ago, and found wanting; supposed new and simpler processes have long been in use, but have been discarded by the best practitioners

as not economical; and plants mentioned as especially suited to the silo have already been pitted, and given unsatisfactory results by reason of the want of chemical constituents requisite to the perfection of the process.

The object of these pages is to lay before beginners some information as to what to do and what to avoid. It is undesirable, on every consideration, to start with the notion that all is so easy, success so certain, and cost so trifling, that you cannot do wrong in trying the process. Exaggerated accounts in this respect are certain to produce a countercurrent. People who are misled by such statements, and who have not taken the precautions necessary to obtain good results, are sure to cry out that the process is a deception; that they have spent so much in hard cash, have wasted so many tons of fodder, and have obtained in return only a mass of manure.

That the cost may be trifling under certain circumstances, is one advantage of the process, as many persons who cannot afford a large outlay are thus enabled to carry out experiments with their ordinary crops. But they must not run away with the idea that, because the process is easy, they can dispense with precautions necessary to safety. If they are unwilling to take the trouble requisite to ensure success, they had better leave the matter alone, or they may only waste their materials. With due care, good results may be obtained with small means and rough appliances; but such results must not be expected to be as perfect in all respects, nor eventually so economical, as those which can be obtained by the employment of large, well-designed, and permanent structures. It is not by any means essential that people should begin with costly works; these may, if desired, be afterwards carried out by those who can spare the capital, and who have satisfied themselves by tentative experiments that a judicious outlay on a liberal scale will be a saving of money in the end.

Much of the advice here given is based on the writings of M. Auguste Goffart (of the Château de Burtin, Nouan-le-Fuselier, Loir-et-Cher), who may be said to be the father

of the most approved modern process known as *ensilage;* for although many French as well as German agriculturists have practised the system for years, in some form or other, he especially distinguished himself by the improvements he introduced, and the currency he gave to them by his book on the subject.* The word *ensilage*† means storage in a *silo* or pit, and is of comparatively recent origin. The ancient practice of using pits as stores for farm produce (more especially grain) dates back for thousands of years. Old Greek writers mention these pits by the name of *siros;* Latin authors use the word *sirus*—so that storing of corn in a pit would be to put it *in siro.* As in many other words, the letter *r* got changed into *l* in course of time; and old Spanish and French books show that *silo* was the word used for such pits centuries ago. With respect to this subject, Mr. B. H. Cowper wrote in the *Field* as follows:

The word *silo*, which is found in some of our dictionaries, also occurs in French, Italian, and Spanish, and denotes a kind of cave, well, or pit sunk in the ground for the storing of grain, &c. The Spanish also have the verb *ensilar*, which signifies the putting of corn in a silo to preserve it. In the Latin, the word *sirus* or *syrus* is to be found; and in Greek we meet with *siros*, both being the same in sense as silo, and only older forms of that word. Where the term originated we cannot say; but possibly one of the Latin writers is correct in ascribing it to what he calls "the barbarians."

Pliny, in his Natural History, book xviii., chap. 30, after describing mowing machines worked by cattle, and other processes during and after harvest, mentions that corn is well preserved in trenches which they call *siri*, as in Cappadocia and in Thrace. In Spain and Africa, he says, they

* Manuel de la Culture et de l'Ensilage des Maïs et autres Fourrages verts. Par Auguste Goffart. Paris: G. Masson, 120, Boulevard St. Germain.

† Mr. Jenkins suggests, in the R.A.S. report, that the word *ensilage* should only be used to describe the process, and that the product should be called *silage*. As a great portion of this book was already printed, we are not able to carry this out fully; but the suggestion is a good one. The inconvenience of using the same word in two senses has been experienced by the French, who commonly substitute *conserve* as a designation for the product; but this expression does not adapt itself well to English use. The employment of *ensilage* as a verb, and the formation of such words as *ensilaging*, we think should be avoided; and *ensile*, as adopted by Mr. Woods, is scarcely suited to the generality of farmers and farm-labourers. They find it more convenient to use the original word in just the same way as they say *to stack*, or *to pit*, or *to hoe*; and there is no more difficulty in making the necessary inflections in the word *silo*, when used as a verb, than there is with our ordinary words *to do* and *to go*.

are specially careful to have these in a dry soil, and spread chaff or stubble underneath, and the grain is laid up with the ear. Thus protected it will suffer no harm; and Varro observes that corn thus stored will keep for fifty years, and millet for a hundred. Pliny is indebted to Columella and Varro for most of his information. Vitruvius, who refers to the same kind of thing, calls the silo a vault. Quintus Curtius alludes to the custom as prevalent in the Caucasus. To the foregoing, Nonius and other ancient Latin authors might be added, especially Tacitus, of whom more anon.

Among the Greeks who speak of the silo or *siros* are Euripides, Theophrastus, Hesychius, and Suidas. In the Greek language there was also a curious word, *siromastes*—a kind of instrument with an iron point or prong, for probing the corn pits or silos to see if contraband or other improper goods were secreted in them. This was also used in time of war—for instance, to find out whether hidden pits existed to catch unwary horsemen, and so forth. It seems to have often proved a serviceable weapon as a lance or javelin; and in this way it is spoken of in the Greek version of the Old Testament. Thus, in 2 Kings xi., 10, Jehoiada is represented as giving the centurions the *siromastæ* of David. The same use of the word appears in Numbers xxv., 7; Judges v., 8 (in some copies); 1 Kings xviii., 28; and Joel iii., 10. Even if the Greek translators were wrong in their rendering of the Hebrew, it is evident that they were familiar with the name of the instrument, the etymology of which is so clear and suggestive.

That the ancient Hebrews did bury or cover their corn is evident from Jeremiah xli., 8, where we read that certain men saved their lives by saying, "Slay us not, for we have treasures in the field, of wheat, and of barley, and of honey." Possibly some other text points to the same thing; but it may be well to quote a short passage from the article "Barn," in Cassell's Bible Dictionary. The writer says: "In ancient times it (the barn) was almost always underground; and from numerous specimens of such repositories yet to be seen in Syria, we find that it consisted of an opening above, which gradually became larger as the excavation deepened. When it was not in use the aperture was closed and covered with earth, but when it was empty it was left open."

It may be here observed that the foregoing description naturally reminds us of the ancient pits in our own country, as in Kent and Essex, which some, like Camden in his "Britannia," have thought were intended for a similar use by our remote ancestors. Camden illustrates his idea by referring to a passage in the "Germania" of Tacitus, where we are told that the Germans had underground pits, which they covered with dung, and which served both for a refuge in winter and as a receptacle for crops (chap. 16).

That the practice was ancient and wide spread we have seen, and that it is no novelty in modern times will be made apparent. The silo is said to be still in use in Sicily; and as regards eastern lands the evidence is abundant. In Cobbin's Condensed Commentary on Jer. xli., 8, the follow-

ing occurs: "In Barbary, when the grain is winnowed, it is lodged in subterraneous repositories, two or three hundred of which are sometimes together, the smallest holding 400 bushels (Shaw). They are in great numbers near Aleppo (Russell). There are deep pits at Rama in the Holy Land, designed for holding corn (Le Bruyn). Three large vaults at Joppa were used for the laying up of grain (Ranwolff)." In Conder's "Tent Work in Palestine," in the chapter on the Fellahin we read, "The corn is stored in underground granaries, which are carefully concealed, and form traps for the unwary horseman, These granaries (Metâmîr) are often under the protection of the Mukâm, and are therefore excavated near that building. They are circular wells some four or five feet deep, and the mouths are closed with clay like that used for the house roofs." Tyrwhitt Drake and Burton also mention silo-like holes found in Syria. We understand that the practice is followed much further east, at Merv and in Turkestan, for example. Mr. W. G. Browne, who travelled in Egypt, &c., in the years 1792–1798, when describing harvest operations in Darfur, gives the following interesting details: "When threshed—which is awkwardly and incompletely performed—they expose the grain to the sun till it becomes quite dry. After this a hole in the earth is prepared, the bottom and sides of which are covered with chaff, to exclude the vermin. This cavity or magazine is filled with grain, which is then covered with chaff, and afterwards with earth. In this way the maize is preserved tolerably well." (2nd edit., 1806, p. 321.) This carries us further into the S.E. of the African continent, and nearer to the equator than any other example I have found. Nearer home we are told that in some parts of Ireland oats are stored in a similar fashion; and we have all become familiar with the laying up of potatoes, turnips, and other roots in this country by covering them with earth.

The earliest date at which I have yet found the actual word "silo" is 1569, when it occurs in the margin of a Spanish Bible, at Jer. xli., 8. Here, while rendering the *matmonim* by *thesoros*, *i.e.*, "treasures," the margin reads "silos escondidos," or "hidden silos."

The use of these grain-pits in France nearly three centuries ago is shown by the following paragraph translated from Férussac's "Bulletin:"

Silo discovered in the Environs of Berre (Bouches du Rhone).—M. Toulouzan, in the paper "L'Ami du Bien," vol. ii., 1828, p. 155, notes the discovery of an excavation containing corn partly in good preservation, after an interval of 235 years. The excavation was formed in 1591 by orders of the Duke of Savoy, who was besieging Berre, and it was a "veritable silo," used to store food for the troops. The custom constantly occurs in Provence, at all epochs, back to the time of the Romans.

In the present day, stores of a somewhat similar kind are

in use in various parts of the world. Mr. Frank Parker, J.P., writing to the *Field* from Indwe Park, South Africa, said:

The natives of South Africa know no other method of preserving grain for consumption except this one—of burying it in the ground; but if they store it for seed and sowing purposes, it is packed away in clay huts, in reed baskets of an immense size.

The Kafir word for a grain pit is *essisile*, which struck me as being very similar to silo. The plan of pit-making in Africa is as follows: A Kafir with some sharp tool makes a small circular hole in the ground, large enough to stand in. He then excavates the ground, scraping it out with his hands, working the hole larger and larger the deeper he goes. In this way, supposing the entrance to the pit is 20in. in diameter, the bottom would be perhaps 5ft. across. The grain is then thrown in loosely —it may be wheat, maize, or Kafir corn—a stone is then placed on the pit's mouth, and earth over this, stamped down with the feet until quite hard and air-proof.

Mr. J. W. Boddam-Whetham (author of "Pearls of the Pacific," &c.) says, in a letter to the *Field*:

The silo system has been long known and practised by the natives of the South Sea Islands. In many of the islands of the Southern Pacific the natural products of the soil, such as cocoanuts, bread fruit, bananas, taro, and yams, are almost the only means of subsistence; and, as a year of plenty is frequently followed by a year of great scarcity, the inhabitants provide for the latter season by preserving the surplus of the former. Their mode is as follows:

A large rectangular pit, 6ft. or 7ft. deep, is dug in the ground, and the sides well lined with plantain or other thick leaves sewn together. The fruits or vegetables are then stripped of their skin and thrown into the pit, which is then covered with more leaves, and heavily weighted with large stones. Small spaces are left between the stones so as to allow the gas generated by fermentation to escape, and this fermentation is sometimes assisted by the introduction of pungent fruits and strong-smelling herbs.

Sometimes the pits are very large, and in one of the Samoan Islands I was shown one 8ft. square and 14ft. deep, belonging to a chief, and, when orders were given, it had to be filled from the contents of the smaller pits owned by his subjects. I was told that its contents would remain good for three or four years, and that "maî" (as it is called in Samoa), like good wine, improves by age.

Col. Burnaby in his "Ride to Khiva," and Mr. O'Donovan, in "The Merv Oasis," both allude to the subject. Mr. O'Donovan says (Vol. II., p. 100), "We picked our way with

difficulty among the shallow pits which served as granaries for the storage of the corn of the Turcomans. The grain is first covered with straw, and then with earth. This system seems to result very satisfactorily, and I have seen corn taken from these receptacles in excellent condition after many months." And Col. Burnaby shows that, not only corn, but green fodder is preserved in pits, for he says in Chapter XXIV., in the ride between Kasala and Khiva: "We now encountered a party of men and women who were engaged in unearthing a quantity of grass from a deep cutting in the ground. This grass had been mown the previous autumn, and was thus preserved until such time as the owner required it, the extreme cold, or perhaps the dryness of the air, keeping the grass as fresh as the day it was cut."

It is unnecessary, however, to dwell longer on this part of the subject. Suffice it to say that a German named Klapmeyer described, about a century ago, a method of fermenting green fodder, and thereby producing a so-called "brown hay;" and, with some amount of variation the process of pitting green crops is carried out in many parts of Germany, Austria, and Hungary as a means of making "Sauerfutter" (sour fodder) or "Viehsalat" (cattle salad). The article by Professor J. F. W. Johnston, published in the "Transactions of the Highland and Agricultural Society," in October, 1843 (page 61), relates to this process; and it is interesting to note the close similarity, in many respects, to the process as it has been carried out in this country by some experimenters. The particulars quoted are taken from the "Verhandlungen des Baltischen Vereins für Förderung der Landwirthschaft" ("Transactions of the Baltic Association for the Advancement of Agriculture"), and are introduced by Professor Johnston as follows:

When green grass or clover approaching to maturity is first cut down, it contains a considerable proportion of starch, sugar, and gum, still unchanged into woody fibre, as it would mostly be were the plant allowed to become fully ripe. But when left to dry in the open air, the circulation proceeds to a certain extent, and, under the influence of light, woody fibre continues to be formed in the upper part of each stem until it

becomes completely dry. It may even be a matter of doubt whether this process of change does not often proceed after the hay has been carried off the field and stacked. The effect of this change will obviously be to render the dry hay less digestible on the whole, and consequently less valuable as food than the green grass from which it was prepared.

Again, we know that by drying, many very digestible and nourishing substances become less soluble, and consequently more difficult of digestion. The stomach of a growing animal cannot afford the time necessary to the complete digestion of such dry substances, and hence a larger portion of the really nutritive matter of their food is rejected in the droppings of animals which are fed upon them. How much of dry corn escapes half digested from the stomach of the horse—how much, probably, of the animal matter of the bones it eats from the stomach of the dog—which either of these animals would have been able fully to digest, and to work up for its own sustenance, had the food been presented to it in a less hard and solid state. So it must be, to a certain extent, with dried hay. What was easily soluble and digestible in the green, has, without undergoing any chemical change, become less soluble and more tardily digestible in the dry, and hence a second reason why the hay should afford less nourishment than the grass from which it was made.

The knowledge of these two causes of deterioration suggests the kind of inquiries which the practical farmer ought to make, and the kind of practice he ought to adopt, in order to retain as much as possible of the feeding property of his grass and clover crops, and thus to turn to the greatest advantage the annual produce of his land. Thus he may ask—Is it possible to preserve these crops in their moist state? Can I cut them down and so preserve them, undried, as to obtain from them, for my cattle, an amount of food more nearly equal to that which the fresh cut grass is capable of affording?

A method has lately been tried in Germany, which, by the aid of a little salt, seems in a great measure to attain this object. Pits are dug in the earth from 10ft. to 12ft. square and as many deep; these are lined with wood, and puddled below and at the sides with clay. They may obviously be made to any other suitable dimensions, and may be lined with brick. Into this pit the green crop of grass, clover, or vetches, is put just as it is cut. 4 or 5 cwt. are introduced at a time, sprinkled with salt, at the rate of 1lb. to each cwt., and, if the weather, and consequently the crop, be dry, two or three quarts of water to each cwt. should be sprinkled over every successive layer. It is only when rain or a heavy dew has fallen before mowing that, in East Prussia, this watering is considered unnecessary. Much, however, must depend upon the succulency of the crop. Each layer of 4 or 5 cwt. is spread evenly over the bottom, is well trodden down by five or six men, and especially is rammed as close as possible at the sides with the aid of wooden rammers. Each layer is thus salted, watered if necessary, and trodden in succession, till the pit is perfectly full. Much depends upon the perfect treading

of the grass for the exclusion of the air, and, therefore, for a pit of 10ft. square, 4 cwt. is as much as ought to be put in for each layer. Between each layer may be strewed a few handfuls of straw, in order that, when emptying the pit afterwards for the daily consumption of the stock, the quantity taken out may be known without the necessity of a second weighing. When the pit is full, the topmost layer is well salted, the whole then covered with boards or a well-fitting lid, and upon these a foot and half of earth, for the more perfect exclusion of the air. A pit 10ft. square, and as many deep, will hold about 5 tons of fresh grass, and each pit should, if possible, be filled in not less than two days.

When covered up, the grass speedily heats and ferments, and, after the lapse of about six days, when the fermentation has ceased, the whole has sunk to about one-half of its original bulk. The lid must be examined during the fermentation, at least once a day, and the earth, as it sinks, carefully replaced, wherever crevices appear; for, if the air be allowed to gain admission, a putrefactive fermentation will come on, which will impart a disagreeable odour to the fodder, though it will not prevent it from being readily eaten by the stock. When the first fermentation has ceased, the lid may be removed, the pit again filled with fresh grass, trodden in, salted and covered as before. A pit 10ft. square, when perfectly full of this fermented grass, will contain nearly ten tons—equal to two or three tons of dry hay.

The grass, when thus fermented, has the appearance of having been boiled, has a sharp acid taste, and is greedily eaten by the cattle. The pits should be kept covered for, at least, six weeks, after which they may be opened successively as they are required and may be kept open till their contents are consumed by the cattle without suffering any injury from the contact of the atmospheric air.

Of the feeding qualities of this salted fodder, one experimenter says that, by giving only 20lb. a day of it along with chopped straw, he kept his cows in condition during the whole winter. His green crop was vetches, and the 20lb. of salted fodder were equal to, or would have made less than 4lb. of vetch hay. Another experimenter says that, on a daily allowance of 28lb. of his salted fodder, his cows gave a rich and well-tasted milk.

This method of salting and preserving green crops in their moist state appears to afford an answer to the first question which is naturally asked when we are told of the difference in feeding value between the same grass when first cut and dried into hay. It is probable that the fermentation which takes place in the pit may in some degree diminish the nutritive value of the grass, but the likelihood which exists that a very large proportion of this value will be retained renders the method of salting in this manner well worthy the attention of our more skilful agriculturists. It would greatly benefit both theory and practice also were a careful series of experiments to be made in different localities, with the view of determining the true relative value in feeding stock of

the grass of the same field when newly cut and when salted and preserved in the manner above described.

There is a rather remarkable similarity in the process here described and that carried out at Merton, as described at pp. 260-1, as regards method of salting, ramming with wooden rammers, &c.

More than thirty years ago Klapmeyer's process* was tried by M. Goffart, but he found the result not nearly so satisfactory as he wished, and then he began experimenting on his own account, and has little by little brought his method of preserving green crops to its present highly improved, if not perfected, state of practice; and having commenced with small silos less than three cubic yards each in capacity, he has gone on building others larger and larger until his storage of green fodder exceeds 1000 tons a year. He admits that he had but meagre success at the beginning; but he persevered nevertheless, changed his mode of practice, and thus eventually extended the time of keeping from a few weeks to double as many months. He says he has found it necessary to alter his opinions, and to retract advice which he gave years ago; but he only does so when he has proved by experience that he can obtain more profitable results by changing his method of procedure, and he may therefore be looked on as a safe man to follow.

The information here given, however, will not be limited to the teachings of M. Goffart, but will be greatly supplemented by the practical experiences obtained of late in the British Islands, and will include many particulars taken from articles and letters in the *Field* and other journals, as well as the official report of the Agricultural Department of the United States.

* In Martin Doyle's "Cyclopedia of Practical Husbandry," published in Dublin in 1839, is given an account of a method of making brown hay, recommended by the Rev. Mr. Klapmeyer of Wormen, in Courland. The clover being cut is allowed to lie for a day or so to get partially dried, then formed into heaps, and trodden, and left to ferment for a time, according to the state of the weather, before being stored. The article originally appeared in the *Irish Farmers' Journal*, to which it was communicated by Mr. John Taylor.

CHAPTER I.—SUMMARY OF PRACTICE.

[This chapter is only intended to set forth briefly the course suggested to be followed, without entering into the why and the wherefore. References are made, from time to time, to the pages in which reasons and authorities are given.]

THE silo should be secured from any invasion of water, whether from above or below. (P. 39, 105.) You need take no trouble in trying to make it air-tight at the surface. (P. 126.)

Where liable to infiltration of water, simple earthen pits should be avoided (p. 39); and, at the foot of rising ground, the pressure of subterranean water may even force an opening through cemented floors, unless made of a good thickness. (P. 223, 229.)

When silos are constructed wholly above ground, and not inside barns or other buildings, it is desirable to avail oneself of any shade that is obtainable. Warm weather prejudicially affects the silage, and it tells most on that which is above ground. (P. 50, 134.)

The walls of the silos are best made perfectly upright. (P. 53.) If they have a "batter" or slope, proper settlement is obstructed (p. 160 H); and, even if the boards do not hang, more weight is required to force down the mass at the sides, where compression is most needed.

Walls should be smooth, to facilitate settlement. (P. 53.) When earthen pits are dug in soils where there is no fear of flooding, the walls may nevertheless be smoothly plastered with advantage, or lined with planed boards, set up on end—which is better than having the boards laid horizontally.

When the fodder is cut, it should be got into the silo as soon as possible. (P. 110.) The longer it is allowed to lie and wither in the field, the less likely it is to keep well.

Crops for the silo are best cut when young and succulent. Green rye should be cut about the time when the head begins to be formed, oats when in blossom or in the milky condition, and clovers and grasses as soon as they come into flower.

Grasses, clovers, vetches, &c., need not be passed through the chaff-cutter before being put into the pit, especially if they are young. (P. 114.) But the stronger and more elastic the stems of the plants the more weight will be requisite to compress them. When the crops are allowed to stand till the stems become old and woody, it may be preferable to pass them through a chaffing machine, as they would then pack well with less weight.

It is not necessary, with our ordinary fodder plants, to mix straw, or other dry material to absorb the moisture. (P. 111.) Such admixture would be likely to do more harm than good, so far as regards preservation of the silage.

If you have dry fodder that you wish to make more palatable to the stock, a small quantity might, for that purpose, be mixed with very succulent crops; but you must be careful not to add too much, or you may endanger the condition of the whole. (P. 110.) Few of our crops would admit of the addition of a tenth part of dry fodder.

Rain need not prevent the storage of crops in the silo. (P. 111.) More damage is likely to arise from letting the crops lie long on the ground than from pitting them in a moist or even wet condition; but, for all that, an excessive quantity of water should be avoided.

Salt is not required for the purpose of preserving the fodder. (P. 122.) A moderate quantity may be useful to the stock; but, if added largely, it is likely to check the flow of milk. (P. 123.)

The fodder, on being put into the silo, should be spread evenly, to prevent the occurrence of lumps in some places and hollows in others; and then it should be trodden down, more especially alongside the walls. (P. 124.) Some farmers turn horses or bullocks into large silos, to do the treading;

but they cannot get so near to the edges as men, who can do good service by going round sideways with their heels close to the walls. Elsewhere the trampling is of minor importance.

Unless heavy weights are put on the mass after the silo is filled, the previous trampling will have been of small avail. (P. 129.) It matters little how the pressure is put on, so that it is sufficient and continuous. It is even more wanted at the end of a long period than it is at the beginning.

With well-formed silos and smooth walls the weight should not, as a rule, be less than 100lb. to the square foot. (P. 128.) With rough appliances the weight may often be doubled or trebled with advantage; but it is less necessary with wet fodder. (P. 259.) When earth is used it should be piled on to the depth of 1½ft. or 2ft., and especial care be given to the trampling down at the edges of the pit.

Between the weights and the siloed fodder there should be a layer of straw—the dryer and harder the better (p. 125); or a layer of pine-needles, gorse, heather, reeds, or some other substance that will not readily mat together, but will allow the air to escape freely as the mass becomes more and more compressed. (P. 125.)

Boards are usually laid upon the layer of straw, &c., before the weights are put on. (P. 127.) They have a decided advantage wherever lumps of stone, barrels of earth, or any rough weighty matters are used. But where the weights consist of matters that pack well together, as evenly-shaped blocks of iron, concrete, cut stone, bricks, or wooden boxes containing clay, &c., the boards may be dispensed with. (P. 132.) Sometimes loose earth is shovelled directly on to the straw; but it is liable to get mixed up with the fodder when the pit is opened. Sand should not be used in this way, as it runs into every crevice.

The weights should, for the most part, be placed at the ends of the boards, close to the walls. If the fodder is well pressed down at the edges, the centre is pretty sure to be all right. (P. 53.)

The boards need not be tongued or made to fit with great accuracy. (P. 127.) A few crevices are useful in permitting the escape of air, which must be forced out by the weight above if the fodder is to keep well (p. 126); and if the mass is well compacted, and the weights are kept on, air is not likely to get in afterwards.

When there are several silos, so that the workmen can be transferred from one to another, it is best to fill the silo slowly at intervals, extending over a week or ten days, a foot or two being put day by day into each pit. (P. 119.) By this means the fodder packs closely, and is so well settled down by the completion of the filling, that nearly all the space in the silo will be utilised. (P. 116.)

If this course cannot conveniently be adopted, the silo may be filled and the weights put on at once. After some weeks, when the mass has settled down, the weights may be taken off, the silo refilled, and then again covered and weighted. (P. 120.) A framework of boards may be used to temporarily increase the height of the silo when filling. (P. 121.)

The silo may be kept six or eight weeks, or as many months, before being opened.

The silage should be cut out from a narrow end of the pit. (P. 56.) The boards and weights should be removed from only a small portion of the surface, and a vertical section made so as to cut out a slice of sufficient thickness for the day's consumption. (P. 139)

The continuance of the pressure during the period of cutting out is most important. If the weights be taken off in advance, mischievous results may ensue. (P. 139.)

The more perfect the ensilage, the less fermentation will have taken place in the pit. Exposure to the air, under such circumstances, is desirable for a few hours, in order to set up alcoholic fermentation before giving the food to the animals. (P. 143.) It thus becomes more palatable.

CHAPTER II.—CROPS FOR THE SILO.

The Grasses.

In these islands, grass has been much more used than any other crop for the filling of the silo; and it is not surprising that such should be the case, seeing how widely it is grown and how generally it is employed for the feeding of our live stock. Great as is the care bestowed on the saving of grass in the form of hay, this care is often rendered of little or no avail by adverse climatic conditions; and one of the chief advantages claimed for the ensilage process is, that it admits of the storage of the crop in any weather. Being, moreover, preserved in a green state, the herbage has a nutritive effect very different from that produced by dried fodder, and much more closely resembling the feeding properties of the grass when freshly consumed in the summer months. For dairy cattle in particular it has been found beneficial, by reason of its producing a more liberal supply of milk, and butter of better colour and flavour, in the winter season, when quantity and quality both fall off under the old conditions of dietary.

In the corresponding chapter of the last edition of this book we particularised the various experimentalists who then had siloed grass crops in this country, and gave in each case a summary of the results. We cannot attempt the same course now, for it may be said of the experimenters that "their name is legion;" and any bare epitome of their doings would become insufferably tedious, seeing that there is not a sufficient amount of variety in the stories of failure to relieve the monotony in the records of success. Suffice it to say that grasses coarse and fine, wet and dry, chopped and unchopped, salted and unsalted, have given considerable

satisfaction to large numbers of bipeds and quadrupeds; and, though it cannot be pretended that an equal degree of excellence has been attained in all cases, there are very few instances in which the experimenter is dissatisfied, or unable to account for shortcomings which he will endeavour to avoid for the future.

It need hardly be said that there are very considerable differences in the qualities of grasses; and corresponding differences must occur in the fodders after conservation. One does not expect to get from the rough "fog" of marshy grounds and the coarse herbage of woodlands the same quality of hay as from good upland grass; and one must not look for equal results in the contents of all silos, either as regards appearance or odour—the latter especially. We have seen pitted grass which had so much the look and smell of hay that it would hardly be taken for anything else by persons who knew nothing of its history. Such samples have remained exposed for days near our writing table without becoming unpleasant, whereas other samples we have been glad to expel from the room in a less number of minutes than these stayed days.

Although there is a peculiar characteristic odour common to most pitted fodders, there appears to be an infinite variety of modifications, without going to crops other than grass. Some samples have a rather pleasant apple-like scent; in others it degenerates into the fetid odour of an unventilated apple store-room; in some there is a more or less cheesy smell, and others give one au idea of rancid butter; while occasionally (and it is to be hoped these are few and far between) samples are met with that call to mind nothing better than a dung-heap. Yet of each we are told, almost without exception, that "the cows eat it with avidity." It is not surprising, however, that many of the horses are more fastidious.

Except by means of exhaustive series of experiments, carefully carried out and minutely recorded, it will be almost impossible to account for these differences, or to trace effects

in other ways—such as waste of material and deterioration in feeding qualities. As far as we are able to judge from evidence that is somewhat wanting in detail (seeing that few persons recount all the circumstances requisite for the formation of a reliable opinion), it would seem that the most hay-like samples are made from the finer grasses pitted with comparatively little moisture in them. Under such conditions they would not compact readily, and, unless submitted to exceedingly high pressure, would be likely to undergo a good deal of heating, and to acquire the strong flavour of over-heated hay, which is very appetising to animals, though it may not, perhaps, be the most nutritious. When there is more moisture, there appears to be less fermentation, or fermentation of a different character; and, if the grass is very wet and there is much pressure, the centre of the mass seems to undergo little change until after it is cut open and exposed to the air. In such case, however, the liquid that exudes from the mass is apt to set up a pungent and sometimes very offensive smell, even when the centre of the mass is almost odourless; and this inodorous provender will usually become more palatable to the beasts after a few hours' exposure to the atmosphere, but deteriorates more rapidly than samples which originally were drier. At all events, such appears to be the case with specimens that have come under our notice; and it was in very coarse rank growths that the tendency to become offensive seemed most pronounced.

Clovers, Lucerne, and Vetches.

Clovers have been preserved in silos by many English gentlemen with more or less success; but they seem to require a greater amount of pressure than grass, owing, no doubt, to the stems being stronger and more elastic, and requiring more force to expel the air which necessarily is intermingled with the fodder when it is put into the silo. In a number of instances, where the clover has been chaffed, we have found the ensilage in capital condition, and some samples of unchaffed clover have also been excellent; but we have not

yet seen anything to surpass the sample from the Vicomte de Chezelles' silo alluded to on p. 198. Owing to the sample being detained for examination at the Custom House, on the supposition that it was a kind of tobacco, the analysis was not made till three weeks after the sample was taken out of the silo, and, from being opened and pulled about, it may meanwhile have undergone some amount of deterioration, as seems probable from the quantity of alcohol and acetic acid; but its nutritive qualities were nevertheless of a very high order. This clover (with which there was some admixture of grass) had been passed through a chaff-cutting machine before being put in the silo. On a previous occasion, however, M. de Chezelles had stored in the silo about 80 acres of clover, put in unchopped, and much of it dripping wet with rain; yet it cut out in capital condition when the silo was opened, nine months afterwards.

With regard to Trifolium incarnatum, M. Lecouteux (who is the author of a capital book on ensilage* as well as editor of the *Journal d'Agriculture Pratique*) says:

The best time to obtain good ensilage from Trifolium incarnatum is to cut it when it is in full bloom, as the plant is then tender. Such has been done with mine at Cerçay this year. I sowed more Trifolium incarnatum than my beasts could consume in the last three weeks of May; about the 15th of May we began to cut it, and we stored it in a silo made in a closed barn. About the middle of July I hope we may begin to consume it, as we did last year.

It is a great thing to be able to store in the silo in spring a supply of fodder against the fearful season of drought which at times parches us up in Sologne, and especially when this early forage is removed from the ground with little trouble and expense, and replaced by other crops, as maize, millet, cattle cabbage, or roots. The feeding of green crops is difficult on dry soils, where we can get fodders in spring and autumn, but little, if anything, that can be cut in the height of summer. Such was my position in Sologne, and I long despaired of being able to get over the difficulty; but the ensilage of Trifolium incarnatum has helped me out of my trouble.

Rain is of little importance when Trifolium incarnatum is being stored. I have put cart-loards into the silo dripping with water, and the fermentation has been none the less perfect.

* "Le Maïs et les autres fourrages verts, Culture et Ensilage. Par Edouard Lecouteux. Paris: Librairie Agricole, 26, Rue Jacob.

Mr. Grant says (p. 226) that he put into the silo a few loads of Trifolium incarnatum, also cut and carried in rain; but this, having been put into a very small pit, and with insufficient weight on the top, did not turn out so well as other samples; nevertheless it was all eaten up by the cows. Mr. Hoare, however (p. 284), is reported to have had very satisfactory results with Trifolium; and Mr. Solomon (p. 285) did well with it in an earthen pit.

Lucerne (which in America is known by the Spanish name of "alfalfa") has been successfully preserved in silos for some years by M. Pornay, of Romorantin; and at the district agricultural show at Bourges, in 1879, M. Pornay was awarded a silver medal for an excellent sample which he exhibited. The Vicomte de Chezelles mentions it among the crops put into his silo, and so likewise does M. Goffart. Lucerne is also a favourite crop in Germany; but we have not heard of many experiments with it in this country. Mr. John Mackay, of Herriesdale, Dalbeattie, is well satisfied with his success in pitting lucerne north of the Tweed; and Mr. F. Beard, of Horton, Kent, is also said to have had satisfactory results.

Sainfoin (frequently spoken of in French, German, and American books by the nàme of "esparsette") is another leguminous plant, very rich in nitrogenous matter, which has been siloed with success. Last season Mr. E. B. Gibson had a very good sample of mixed sainfoin and clover in Essex; and Mr. Biddell reports (p. 272) that chaffed and unchaffed sainfoin have both been well preserved in Suffolk.

Of vetches the reports of experience are rather conflicting. Several persons who have tried them have given in the *Field* very unfavourable accounts of the result. One correspondent, who apparently had taken every care, says that "the vetches appear to be quite rotten, with a fearful smell, and nothing will touch them," although the clover in the same silo was good and sweet, and readily eaten by the cows and sheep. On the other hand, Mr. Easdale sent us a capital sample of vetches from Mr. Stobart's silo, and said: "The cattle eat it with the same alacrity as they do that made

of clover or meadow grass; and the many visitors who have inspected it consider it most excellent, and that the characteristic vetch flavour or smell has been retained in a high degree." Mr. Grant (p. 228) says that "spring vetches and oats make perfect ensilage;" and Mr. Ashforth, of Longley Hall, Sheffield, sent us a sample of oats and tares, which was in excellent condition, and had a very pleasant aromatic odour.

Serradella (Ornithopus sativus) a species of vetch, closely allied to the British species called "birdsfoot" (Ornithopus perpusillus) is much grown in Germany, as well as in Spain, whence it gets its name. Baron Laffert sent us from Mecklenburg a specimen of serradella from his silo, and it was in very good condition, although pitted when dripping wet. This is a plant that might probably be worth cultivating in this country, as it grows on light sandy and gravels near the sea, and is rich in nutritive qualities.

Maize.

Until within the last year or so the works published about ensilage have related almost exclusively to the preservation of maize or Indian corn (ordinarily spoken of in America as "corn," without any prefix); but it is not surprising that such should be the case, seeing that these books were brought out in countries where maize is largely grown, and more used for this purpose than any other crop. Many people, indeed, when it was proposed to introduce the system into this country, seemed to be under the impression that silos would be of comparatively little use without maize, which they looked upon as a more nutritious fodder than our ordinary grass crops. This, however, is a mistaken notion; for, although ripe Indian corn is a very rich cereal, the entire maize plant, consumed as green fodder, is not nearly so nutritious as is often supposed. It is certainly most highly spoken of by M. Goffart, and he cultivates it largely himself—not, however, because it is more nutritious, but because it suits his soil much better than many other crops; and he says that his land will

produce double the weight of maize that it will of mangold. Moreover, he contrives to get two crops a year off the same ground, by cutting green rye in May, and immediately afterwards planting maize, which is sufficiently advanced towards maturity by the autumn to answer his purpose. In America, too, maize is grown on so extensive a scale, that any mode of preserving it as green fodder, where other winter foods are difficult to obtain, must necessarily cause the system to be widely adopted among the myriads of farmers who dwell on that vast continent.

The advantage of maize as a fodder plant is therefore beyond question; though its value lies, not in its inherent richness, but in its abundant growth and consequent cheapness, where soil and climate are suitable. It is not, indeed, so nutritious as fodders ordinarily grown in these islands, as will be seen by the following remarks of M. Goffart:

> Now, is maize in itself a rich food? Evidently not. Besides the analyses, more or less exact, which have been published, one unanswerable fact proves that it is not rich in nutritive principles, and that is, the large amount which must be eaten to keep beasts in good condition. Nobody would maintain that a given weight of maize would replace the same weight of lucerne, clover, or sainfoin; but that does not prevent anyone from making up by quantity what is wanting in nutritive properties. . . . I need hardly say that green rye is much richer than maize, and that a smaller quantity of the former feeds as well as a larger quantity of the latter: a mixture of these two fodders constitutes an excellent regimen.

American agricultural authorities of high repute also speak of it as a "one-sided food," requiring the addition of more nitrogenous material to bring up its feeding value. And now we have evidence of a similar character with respect to some which has been grown in England, where, probably owing to lack of sunshine, the maize proved to be poorer in nutritive principles than that grown on the Continent or in America.

Mr. Sutton, in his analytical report on the green crops and ensilage alluded to in Mr. Woods' lecture, at South Kensington, in March last (published in a pamphlet by Hamilton, Adams, and Co.), says: "It cannot be disputed that maize, as grown here, is weak in nitrogenous and saccharine con-

stituents as compared, for instance, with rich grasses or clover; but, on the other hand, the enormous weight of the crop which may be grown acts as a compensation."

Mr. Woods, in his balance-sheet, makes this compensation assume wonderful proportions, seeing that his figures show about double as much profit on maize as on grass, although the cost of cultivation, &c., is considerably heavier on the former crop. The following are Mr. Woods' summaries; but he also gives in his pamphlet full details of the outlay.

VALUE OF ONE ACRE OF GREEN MAIZE MADE INTO ENSILAGE.

	£	s.	d.
1 acre of maize, cut green, weighed 28 tons, and produced 26 tons of ensilage, value 26*s.* 8*d.* per ton, being one-third value of hay at 4*l.* per ton	34	13	4
Deduct rent and tithe, cost of cultivation, manure, seed, cutting, carting, chaffing, filling silo, and all other expenses, including interest on cost of barn silo	14	3	10
Nett value of ensiled maize per acre	£20	9	6

VALUE OF ONE ACRE OF GRASS MADE INTO ENSILAGE.

	£	s.	d.
1 acre of grass weighed $12\frac{3}{4}$ tons, and produced 12 tons of ensilage, value 26*s.* 8*d.* per ton, being one-third value of hay at 4*l.* per ton	16	0	0
Deduct rent and tithe, cost of cutting, carting, chaffing, filling silo, and all other expenses, including interest on cost of barn silo.................	5	4	9
Nett value of ensiled grass per acre......	£10	15	3

On paper, this certainly looks well for the maize; but it will be observed that Mr. Woods obtains his results by assuming for the maize the same value per ton as for the grass. The analyses, however, do not support this assumption. Mr. Sutton says: "The figures of analysis speak for themselves; but in judging of the results we must look at all the materials as being in a perfectly dry state." This observation Mr. Woods does not appear to have sufficiently considered; for he takes his ensilage of different crops as being of equal value, notwithstanding that the proportion of nutritious matter in his maize is less than half what it is in

other crops. To make this more obvious than appears in the ordinary form of analysis, we select from Mr. Sutton's table the percentage figures relative to the ensilage of maize and grass above alluded to, and place alongside, for comparison, the quantities per acre of the respective constituents. It will have been seen, from Mr. Woods' summary, that the ensilage of the crop of maize was equal to 26 tons per acre, and that of grass to only 12 tons. We accordingly turn the percentage of water and other constituents into tons per acre, so as to make up these respective totals.

Constituents.	Percentage Composition.		Tons per Acre.	
	Grass Ensilage.	Maize Ensilage.	Grass Ensilage.	Maize Ensilage.
Water	73·530	86·280	8·82	22·43
Albumenoids	2·805	1·149	**0·34**	**0·30**
Carbo-hydrates	11·605	5·186	**1·39**	**1·35**
Woody fibre	8·140	5·075	0·98	1·32
Ash	3·920	2·310	0·47	0·60
	100·	100·	12 tons	26 tons

Among the constituents, there are (to quote from Mr. Sutton's remarks) "only two classes of really nutritious matters, namely, albumenoids or flesh-formers, and digestible carbo-hydrates or fat-formers." These (which are here printed in more conspicuous figures) are both shown to be higher in the acre of grass than in the acre of maize, while the chief difference in the two crops consists in the excess of water in the maize—the extra 14 tons being wholly worthless material; yet all this is included in the account at the rate of 1*l.* 6*s.* 8*d.* per ton. If, however, this excess of worthless material were deducted from the sum quoted above, the nett value of the maize would cut a comparatively poor figure alongside that of the grass. And it may be observed, in addition, that, owing to the extra bulk, the silo to contain the maize would have to be double the size of that required for the grass.

It must not be forgotten, too, that all soils are not equally well adapted for the cultivation of maize. If it were a question solely of temperature, it might be expected to thrive better in the southern counties than in Norfolk; yet Mr. A. Grant says (page 228): "Even in the mild climate of Hampshire I cannot make maize a success. On wonderfully rich and carefully-worked soil, saturated with manure, I have grown maize 7ft. high, and with very thick strong stems; but the first heavy wind from the south-west blew it all down; and in the fields it grew fairly well, say 5ft. high, and very thick, but the same fate overtook it. A neighbour of mine tried it in a fairly good field, but it was useless as a crop."

Mr. Bateman relates much more successful experiments in Essex, in the following extract from a letter in the *Field*:

Maize as fodder certainly succeeds in England, but will seldom ripen. Mr. Stannard, of Elmstead Market, Essex, grew half an acre of it in 1880, and was so well pleased with the result as green fodder for farm horses, that he grew two acres of the same crop in 1881. I saw this. At a rough estimate it would weigh 35 tons to the acre. The land (1 acre), sown with "flat" maize seed, grew strong and stiff to a height of from 9ft. to 9½ft., while that planted with "round" seed only reached from 3ft. to 4ft. in height. I may add that Mr. Stannard's farm was a poor clay, dear to rent at 25*s*. per acre.

In 1882 I induced a tenant at Brightlingsea to try the same crop on far superior and lighter land. He procured some good "flat" seed and sowed in April, which experience teaches was two months too early. It germinated well, was cut to the vitals by a frost early in May, partially recovered, and was, when cut in August-September, 1882, but a partial success, only reaching a maximum of 4ft. high, with an approximate weight of fourteen tons to the acre.

On the same farm we tried planting 3½ acres for ensilage in 1883. It was sown on June 1, and again on June 14, the first sowing having proved to be thoroughly bad seed, only 20 per cent. of which sprouted. The second sowing on the same ground was also with very inferior seed, which hardly germinated better than the first. This of course gave trouble in keeping the land clean. The crop had reached from 7ft. to 9ft. in height by Aug. 31, 1883, when its progress was suddenly checked by the biting gale of Sept. 1, which stopped all further growth and withered the tops. Cutting took place on Sept. 6, when we chaffed the whole and siloed it. The result is certainly satisfactory; all stock seem to like it

and thrive thereon. We were, however, somewhat frightened by the floods of juice exuding from the silo, and stopped at 70lb. pressure, which was hardly enough to prevent the ensilage taking an acid turn.

How far this success would be borne out in a succession of years, experience only can determine. Dr. Voelcker, speaking at the Society of Arts, after a lecture on ensilage, said "He had grown maize in England, and also sorghum, but the crop depended very much on the season; one year it was a beautiful plant, 7ft. high; and next it was only about 3ft., and the cattle would not look at it. Two years ago he grew maize on the Experimental Farm, but it came to nothing. It was too uncertain a crop for this climate."

Without wishing to discourage experiments in the culture of maize in these islands, we think it desirable that persons who attempt it should proceed cautiously, and not make large ventures until they have ascertained whether it is likely to succeed on their soils. M. Goffart says: "There are certain indispensable conditions in the physical, hygrometrical, and chemical condition of the soil, the absence of which may render the profitable cultivation of this forage impossible." In his own case, where the soil is favourable, he manures heavily with farmyard and artificial manures, and thus, if the crop does not turn out well, there may be a heavy loss. These matters ought to be taken into consideration, and M. Goffart does not hide them; for, although he is a very warm advocate of maize-culture, where conditions are suitable, he nevertheless says that "Maize is a ruinous crop in bad seasons. Nothing is more advantageous than a successful maize crop; nothing more ruinous than a bad crop of maize. More than 40 tons an acre on the one hand, and less than 6 tons an acre on the other. Such are the divergencies that I observed in fifty places in 1878."

Green Rye and Green Oats.

Green rye is a favourite crop for ensilage with many French farmers. M. Goffart grows it largely, gets it into the silo in May, and immediately plants maize on the same ground. It

has also been siloed in England. At a meeting of the Society of Arts Mr. E. B. Gibson said that in the previous May he had put into silos the produce of twenty acres of green rye, cut just as it was coming into ear, and passed through a chaff-cutting machine before being siloed. At the time of the meeting Mr. Gibson was feeding forty head of cattle on $1\frac{1}{2}$ bushels of this product, with $1\frac{1}{2}$ bushels of swede turnips, and 2lb. of cotton cake each per day; and they throve so well that he thought the cotton cake might be dispensed with without any diminution in the milk. So satisfied was he with the results, that he intended to put into the silo a larger quantity of green crop; and he felt certain that heavy land farmers would find it highly beneficial to substitute ensilage for roots. The particulars of Dr. Voelcker's analysis, given at page 273, show that this rye ensilage was good food, though not so rich as that made from clover or grass.

M. Lecouteux, writing in the *Journal d'Agriculture Pratique*, says:—"In other parts green rye is spoken of. It is an excellent green crop, which, with abundance of manure, especially artificial manures, gives immense produce. I have tried rye as recommended, chopping it up small at the time of pitting; but the beasts much preferred Trifolium incarnatum, which, thanks to a spring dressing of superphosphate, came almost as early as the rye. I therefore hold to the clover, but without ceasing to recommend rye or any other fodder which may be preferable under different circumstances. Besides, it is well to have several strings to your bow; and rye has this advantage, that it comes at a time when, being chopped up with hay or straw, it facilitates the transition from dry winter diet to the succulent food of spring."

Green oats have been siloed in many cases, especially in Scotland. We received excellent samples of chopped oats from Mr. Miller, of Singleton Park (p. 293), and Mr. Wilson, Rigmaden Park (p. 297); a sample from Mr. M'Connel (p. 324) was rather acid, but otherwise in good condition; and one of unchopped oats, from Mr. Mackenzie (p. 318), hardly came up to the level of the chaffed samples. Among

others who have pitted green oats are Lord Walsingham, Col. Tomline (p. 271), Mr. Whitbread (p. 280), Sir T. E. Colebrooke (p. 318), Lord Blantyre (p. 319), Mr. Urquhart (p. 320), Mr. Dudgeon (p. 322), and Mr. Duncan (p. 330). In some cases, the oats have not been cut as green fodder in the summer, but have been put in the silo because they could not be harvested. Some sprouted oats were pitted very successfully by Mr. Kemble (p. 242).

M. de Moidrey, in the *Journal d'Agriculture Pratique* says: "At that time of the year when oats were liable to be beaten down before the grain is ripe, an excellent method of turning to account those crops which, if they remained laid, would give no produce, is to silo them in a green state. Last year I thus treated about five-and-twenty tons, mixing them with a little lucerne in alternate layers. The oats were half black, and the straw nearly yellow, so that it was necessary to water them. The result was excellent, and all was eaten during the winter by cattle destined to be fattened on pasture. Not only had the grain been preserved in the silo, but it appeared to me to have attained more complete maturity."

Miscellaneous Crops.

Spurrey (Spergula arvensis), also known as "yarr," is a plant that grows naturally in cornfields on very light soils in England and Ireland, but in Germany is largely cultivated as winter fodder for sheep and cattle. Lord Walsingham has experimented with it very successfully on his estate in Norfolk, and Mr. Woods gave some interesting particulars about it in his South Kensington lecture. On twenty acres of blowing sand—so poor in quality that it had seldom produced either corn or roots, and was for several years left uncultivated—spurrey gave 5¼ tons per acre. The ensilage was excellent, and sheep and cattle fed upon the product, mixed with straw-chaff, preferring it to that made from grass. The trial was so satisfactory that arrangements have been made to sow upwards of 120 acres for the present year. Compared with the maize produced on the same estate, the crop of spurrey

was, no doubt, very light, but both crops were not grown on equally poor land; and as regards value per ton, Mr. Sutton's analysis show the spurrey to be worth twice as much per ton as the maize, so far as the nutritive constituents are concerned, there being in the spurrey more than double the quantity of flesh-formers and fat-formers, with a much smaller quantity of water, than was contained in an equal weight of maize. The utility of the crop on almost worthless light soils is thus shown in a very marked degree.

Buckwheat is another crop which has been grown and siloed on Lord Walsingham's estate. There being no analysis of the product, its value as compared with other crops cannot well be estimated; but the green crop being less nutritious than spurrey, it may be expected that the siloed fodder would be so likewise. M. de Moidrey, writing in the *Journal d'Agriculture Pratique,* does not speak at all favourably of buckwheat, for he says :—"Of all the kinds of forage which I have tried in ensilage, green buckwheat has given the worst results. Two years ago I mixed some with maize, and the preservation was good, but the animals could not relish the half-gluey product given by the buckwheat, and it had a narrow escape of being thrown upon the dung-heap. It is much better to keep to maize (mixed or not with second cut of meadow grass) or to clover, and especially lucerne."

Many other kinds of crops have been put into silos by different persons. Before M. Goffart discovered that, by improving his mode of ensilage, he could keep fodder for much longer periods than he had been accustomed to do, the quantity of maize grown by him was comparatively small. In 1872 the crops of his home farm of 300 acres included 40 of wheat, 32 of rye, 80 of oats, 12 of buckwheat, 11 of Jerusalem artichokes, and only $3\frac{3}{4}$ of maize (producing more than 150 tons), besides which his natural and artificial grasses, vetches included, amounted to 600 tons. Six years later his growth of maize had reached 1100 tons. His experiments in pitting crops have been of a widely varied character, for it appears that he has put into his silos maize and rye, various

kinds of clover and trefoil, Jerusalem artichokes, beetroot, sorghum, comfrey, turnips, and potatoes. He says he has been more or less successful with all of them, but makes no special remarks as to his treatment of the majority. With regard, however, to prickly comfrey he gives some particulars, showing that it is very good fodder when freshly cut, but not well adapted for ensilage alone, owing to the paucity of sugary matters rendering it incapable of alcoholic fermentation. He says :

My beasts eat the green comfrey without eagerness, but without repugnance. In autumn, at the time of ensilage, I mix a certain quantity of it with my maize, and obtain very good results. The comfrey appears to be superior to maize in nitrogenous matters, and the maize will come to the aid of the comfrey through its greater richness in certain very useful principles much sought after by the animals.

Maize contains, on the average, only 1·20 to 1·25 per cent. of nitrogenous matters, whilst recent analyses of comfrey credit it with 2·70 per cent. or more than double. These two plants, instead of being opposed, serve to complete one another, to the great advantage of agriculture.

At the beginning of October, 1878, I put in the silo a few tons of comfrey. The fodder was perfectly sound, but it is well known how poor it is in sugary matters, and consequently how little fitted for alcoholic fermentation. The results confirmed our anticipations in all respects. Despite all the care which I gave to this ensilage, I only obtained a "brown hay"—very good food, but quite refractory to alcoholic fermentation. On exposure to the air, the comfrey soon underwent butyric fermentation, and had to be consumed immediately, otherwise it would quickly become unfit for the feeding of cattle.

Other experiments with prickly comfrey have reported unfavourably of the result. It was tried at Glasnevin, at the Albert Institution, being chaffed with lucerne, and mixed with a very small proportion of oat straw. As lucerne is very rich in carbo-hydrates, and thus would tend to remedy the deficiency in the comfrey, while the oat straw would be likely to counteract the excessive amount of moisture, it might have been supposed that there would be a better prospect of success; but Professor Carroll reported that "The comfrey and lucerne were quite spoiled; the colour had not been much altered, but the smell was most offensive, and the mass appeared to be putrid."

In the account of the visit to Mr. Copley's silo, quoted on page 299, it is stated that the cows did not like the comfrey. And Mr. H. M. Jenkins, in his report to the Royal Agricultural Society, says: "I have not yet met with an instance of prickly comfrey making good silage." Mr. A. J. Scott names comfrey as one of the crops that he has failed with. The only exception to the general consensus of opinion that we are aware of has been the evidence of Mr. H. Doubleday, who, in a letter to the *Field* endeavoured to explain the unsatisfactory results by stating that the comfrey siloed by Goffart and others is poorer in sugary matters than that which he has used. He said:

It is stated by M. Goffart that, despite all his care, he had not succeeded in making good ensilage from comfrey. These experiments were made, I believe, eight years ago, and, of course, upon the old varieties. I have practically found no difficulty whatever in making good ensilage from the Russian variety.

It seems very evident that this Russian variety of prickly comfrey is rich in substances convertible into sugar; in fact, there is very little chemical difference between gum and sugar. It is very evident that a considerable amount of sugar was produced in the silo, or the ensilage would not have had such a sweet and vinous smell and the cows have been so attracted by it.

It keeps well in the silo, and we do not want to keep it long when out of it, as it was carted at once from the field into the silo without any chaffing. We chaff it with the addition of a little straw for the cows as we take it out. We are quite independent of roots and also of seasons, for it is a crop that never fails. The produce is very large, and my cows are doing much better than they would on roots.

The solid-stemmed, or so-called Russian variety, is, we believe, merely a "sport" from the comfrey tried by Goffart, and, as we have not seen any comparative analyses, we cannot say what ground there is for the opinion expressed by Mr. Doubleday as to the new variety being richer in gum and mucilage than the old one. But, even if it were so, it does not necessarily follow that it has more sugar. Generally speaking, when gum and mucilage are abundant, sugary matters are scanty. We do not look upon Mr. Doubleday as a disinterested witness, and cannot but consider his description as *couleur de rose;* for we have seen, smelt, and,

unfortunately, handled a sample of Mr. Doubleday's comfrey ensilage, and, so far from thinking it had "a sweet and vinous smell," the writer aud several others considered it to be, without exception, the worst-smelling sample of ensilage that we had ever met with. Soap and water seemed powerless to remove the scent from the hands for hours; and, if this Russian variety is really an improvement upon other kinds of comfrey ensilage, we hope never to have a close acquaintance with them.

In a report, made in 1875 to the National Agricultural Society of France, by three commissioners (Messrs Bella, Moll, and Barral) appointed to visit M. Goffart's farm and inquire into the subject of ensilage, the information given has reference chiefly to maize, but the following remarks are also made with respect to the preservation of other materials, many of which are frequently thrown aside as useless:

> In the Lyonnais district, green leaves of the vine, preserved as food for cattle, and for the goats which have made the reputation of the Mont Dore cheese, have given excellent results from time immemorial. It is the same in cider districts with silos of apple refuse. In various parts of Germany vegetables of all sorts—turnips, cabbages, and divers kinds of leaves, flavoured with a little celery—have been preserved for the feeding of cows for ages as far back in the night of time as cabbages destined for the food of man have been preserved and known under the name of "sour-krout."
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> In the north of France several eminent agriculturists—M. Georges, of Orgival, near St. Quentin, among others—have for more than twenty years past successfully preserved their beetroot leaves in silos; others have applied the same process to sliced beetroots, and have found that they kept better than when the roots were placed whole in ordinary pits and silos. The beetroot pulp from sugar distilleries also keeps well when put into silos.

Beetroot, it need hardly be stated, is but another word for mangold, *betterave* being the French name common to all the species of this genus of plants, in like manner as *mangold-wurzel* is the name used by Germans. Accordingly, unless some distinctive expression, such as *betterave globe jaune* is made use of, one cannot say that any particular variety is indicated; and therefore, where we have used the word

"beetroot" in the translation, it does not necessarily mean that sugar-beet is alone referred to—it may also mean the variety that we should designate by the name of "mangold." Of course, with the beetroot pulp just mentioned there can be no doubt; but the sliced beetroots alluded to a few lines before may equally well mean sliced mangold; and the same remark will apply to various other instances where the word "beetroot" occurs.

M. Lecouteux says, with respect to the ensilage of beetroot or mangold: "It is requisite to cut up your roots in some fashion before being eaten by the stock. If kept whole in pits they are liable to sprout, especially if the winter be mild; and, besides, the necessary quantity will have to be cut up day by day. It is preferable to have them all sliced up in the first instance, and mixed with some straw chaff, and then put into the silo, whence you can take out daily the quantity required for consumption. You will thus have the double advantage of securing better preservation of the crop, and avoiding the inconvenience of setting men and teams to work day after day."

The Commissioners of the National Agricultural Society of France (quoted above) likewise state that sliced roots keep better than those which are left whole. They also discussed the question whether mangold could be profitably grown on M. Goffart's estate, and say:

The question may be asked whether, at Burtin, it would not have been preferable to cultivate mangold (*betterave fourragère*), which also gives considerable returns per acre, and is so easily kept in winter. For anyone who knows the Sologne country, this cannot be a matter of doubt. In other parts there are farms where yellow globe mangold is almost sure to give 40 tons per acre if you give in due season 40 tons of manure. But such results are impossible in Sologne. Mangold is ill adapted to its soil, whereas maize is easily grown there under good conditions, and gives fabulous crops—40, 50, and even 60 tons of excellent forage. Maize is less rich than mangold, no doubt, when both are fresh; but it is better suited to the feeding of milch cows, and is improved by ensilage. We believe we shall not be far from the truth in saying that in Sologne, with equal conditions of culture, the average produce of maize per acre would be at least double that of mangold.

In England the sugar-beet is comparatively little grown; but some remarks made by Mr. Duncan, at the Society of Arts meeting previously alluded to, show that the refuse pulp from the sugar-beet has been found of value in this country as well as in France. Mr. Duncan said that, some considerable time since, when his manufactory was actively engaged in producing sugar from beetroot pulp, some of the waste of the latter, for which at the time there was no use or sale, was placed in a trench, and remained there uncovered for three years. In a period of great scarcity it was taken out absolutely uninjured, except a very small portion of the top, and the neighbouring farmers were glad to give him 12*s*. per ton for it.

The Jerusalem artichoke is a favourite subject with many French experimenters in ensilage. M. Goffart, as will have been seen in a previous extract, grew eleven acres on his farm. In Richardson's "Corn and Cattle Producing Districts of France" (1878), it is stated that districts previously barren, had been brought into cultivation by the help of the silo; and that one of the first crops attempted on the worst of the land was the Jerusalem artichoke, of which the tops were cut, when in full growth, and stored in a silo for winter consumption by cattle. Even in sheer sand, the Jerusalem artichoke will push a growth two or three feet high; and there seems no reason why it should not be grown for its herbage upon soils whereon no crop of tubers can be expected. The tops, however, appear to be more nutritious than the tubers; and analyses published by M. Cottu show that his siloed artichoke leaves contained more than double the nutritive matter there is in siloed maize of equal weight.

Turnip-tops have been siloed with success by Mr. Brougham (see page 331), who found them very serviceable in the spring; and German authorities put the nutritive value of swede turnip-tops as high as that of maize. Mangold tops are rather less valuable, but those of the sugar beet stand higher. Potato-tops also have been siloed, and their value is also put higher than that of maize. Mr. John Mackay, of Herriesdale, says,

that he kept some mangold tops in satisfactory condition; but both mangold and swede tops put into Mr. Pochin's silo (p. 316) are said to have turned out a complete failure.

At p. 342 mention is made of five or six tons of thistles having been siloed, and the cattle ate them freely. Gorse is said to have been put in the pit with rough grass, &c., and to have come out in very good condition; but we saw a sample of gorse that had been siloed separately, and we are not surprised that the cattle would not eat it, for there seemed no more nourishment in it than in a chopped-up dry birchbroom. This, however, must not be taken as a fair specimen of the capabilities of gorse; for it had been cut in December, when there would be no sap in it. If it had been cut early in the year, about the time of blossoming, the result would probably have been very different.

As an instance of multifarious contents in one silo, we may quote from the report of the United States Department of Agriculture the particulars of what was put into his pit by Mr. C. Cromwell, of Rye, New York:—"(1) 18in. of green oats; (2) 6in. of red clover; (3) 6in. of Canada peas; (4) 2in. of brewers' grains; (5) 2ft. of maize, sowed broadcast, and containing more ragweed than maize in the crop; (6) 5in. of grass; (7) 12in. of sorghum; (8) more maize. Came out excellent, fresh and sweet."

Brewers' grains have for many years been preserved in pits in much the same manner as green fodder—this method having been in use long before the name of the "Silo" was known in England. Filberts, walnuts, &c., are also preserved by burying them in the ground. Those who are fond of these fruits, and wish to keep them in good condition, cannot do better than pack them closely in earthen jars, cover the mouth of the jars tightly by some such method as tieing them down with pieces of bladder, and then bury the jars a foot or more underground. They will thus have diminutive silos which will keep the nuts good for many months.

CHAPTER III.—THE VARIOUS KINDS OF SILOS.

It is not desirable to run away with the idea that one pit is just as good as another, and that a rough-and-ready silo will answer quite as well as one that is carefully made. Cheapness does not necessarily mean economy, and not unfrequently it is the very reverse.

One method which has been recommended, and which is very likely to attract beginners, on account of its being easy and inexpensive, is that of heaping up fodder on the surface of the ground and then covering it over with earth. This is utterly condemned by M. Goffart, who says that, except in the case of unchopped maize, he never knew an instance where the results were not bad. This is borne out by experiments at the Albert Model Farm, Glasnevin, Ireland, where grass covered up in this way became so mouldy as to be perfectly unfit for food.

Nevertheless, it is not requisite to go to a large expenditure before making any attempt to preserve green fodder in pits; but it is desirable that the beginner should bear in mind that he cannot obtain from small silos and rough methods of procedure the full success attainable from better appliances. The more carefully all arrangements are carried out, the greater amount of success is likely to be attained. Satisfactory results may, no doubt, be obtained with comparatively small outlay; and where the saving in first cost is of greater importance to the beginner than some waste in the fodder, he can adopt that course which is most convenient to himself.

At the Ensilage Congress at New York, in 1883, one of the speakers said: "In the matter of silos, it makes no difference

whether they cost 25 or 25,000 dollars ; one will preserve your ensilage as well as the other; the only thing required is continuous pressure." But this should be taken *cum grano salis;* for you cannot make small silos as effective as large ones, nor can you pack the fodder so well against rough surfaces as against walls that are smooth; consequently there is more waste of fodder with small pits and rough surfaces than with large silos and smooth walls. Where fodder is so abundant that waste is unimportant, such a statement may pass muster; but it does not accord with the teachings of the gentleman to whom, at that same Congress, an address was voted to "express their appreciation of the great value of the system of ensilage discovered and introduced by him." M. Goffart tried cheap methods, and obtained therefrom results which are not likely to be exceeded by persons of less experience; yet he has given up rough-and ready modes of storage, and betaken himself to silos of masonry as being more profitable in the end.

Earthen Pits, and other Simple Forms of Silo.

All simple methods are not condemned by M. Goffart, although he may have ceased to practise them. In 1876, in replies which he gave to a series of questions put by the "Société des Agriculteurs de France," he said: "I preserve from 300 to 400 tons in eleven silos of various shapes and dimensions. Five are old rectangular rooms, all above ground. Six are oval or rectangular tanks—one half above ground, and the other five almost wholly below ground. The best are the last built, with semicircular ends, and half underground." Since then he has built the large silos alluded to at page 53, and increased his ensilage to more than 1000 tons per annum. At a conference in connexion with the Agricultural Show held at Blois in May 1875, he said, with respect to earthen pits: "The trial of an underground silo, without walls of masonry, has given favourable results, so far as regards loss, which scarcely amounted to 1 per cent. of the fodder put into the pit; but the soil crumbles away rapidly

when the silo is empty, and in this respect it is inferior to walls of masonry."

In a report to the Central Agricultural Association of Sologne in 1875, particulars of some roughly-constructed silos on M. Goffart's farm were given by M. Julien, president of the Romorantin Agricultural Committee, who said:

We visited the silos, some in buildings, and others in the fields. The first consisted of brickwork compartments in an old cart-shed. They were empty at the time of our visit. But a silo in a field was opened in our presence, and, with the exception of some mouldy patches on the upper layers, the fodder was in a very satisfactory state of preservation. Henceforth, however, earthen silos will be done away with at Burtin, the owner finding it advantageous to replace them by silos of masonry, which are more easily managed and give better preservation. . . . . Silos simply dug in the earth should not be of such a depth as to be in danger from infiltration of water. The bottom and walls should be covered with a thin layer of straw, to prevent contact with the earth, and the fodder be then packed in, either cut or uncut. On reaching the surface of the ground, the fodder, having been well trodden down, should receive a thin layer of straw, and then be evenly covered with a good layer of earth, thick enough to prevent the penetration of rain.

With respect to the use of earthen silos among the small farmers of France, M. Lecouteux says:

Silos dug out of sound earth are those generally preferred by small farmers, who do not want buildings of masonry. As I have often said, earthen silos would tend to popularise ensilage on farms where, for some reason or other, they shrink from constructing buildings. At Cerçay [where M. Lecouteux lives] the preference is in favour of buildings; but under these circumstances—that they are barns which are at liberty in April, May, June, July, and part of August, and which consequently may be filled with provender, that disappears in turn, and affords room for the storage of grain crops. Later on, in October, the cereals being thrashed out, the barns become silos for maize. There are thus three successive destinations—silos for maize, silos for trifolium, and barns for cereal crops. It is a suppression of "fallows" in farm buildings; and such fallows are not least in importance where one has to consider whether it is better to lock up money in bricks and mortar or to devote it to reproductive improvements.

Mr. Francis Morris, president of the Ensilage Congress at New York in 1883, is a strong advocate of earthen silos; and in the Special Report of the U.S. Department of Agri-

culture on Silos and Ensilage the following remarks are made with respect to Mr. Morris's operations :

Especial attention is invited to the earth silos mentioned in the statement of Francis Morris, Esq., of Oakland Manor, Maryland. Mr. Morris is a pioneer in ensilage in America, his first silos having been built and filled in 1876. These were in the basement of his barn; walls of masonry. The next year he made a trench in sloping ground, so that a cart could be backed in at the lower end for conveying ensilage to the feeding room. The sides are sloping, and the average depth does not exceed 6ft. The cost is simply the cost of digging a ditch of similar dimensions. This trench was filled in 1877, and regularly since, and has kept its contents perfectly.

Mr. Morris has several silos of the same kind, in different places, for convenience of filling. He uses a large cutter driven by a steam-engine, and packs in the silo by treading with horses. The filling is carried several feet above the surface of the ground, and rounded up at the centre, the excavated earth serving to confine the ensilage. The covering is first roofing felt, then earth for weight.

Mr. Morris has put in whole fodder, and it has kept perfectly. He cuts it fine, mainly for convenience in handling and feeding. Whole fodder (maize) should be laid across rather than lengthwise in the trench, so that it can be taken out easily.

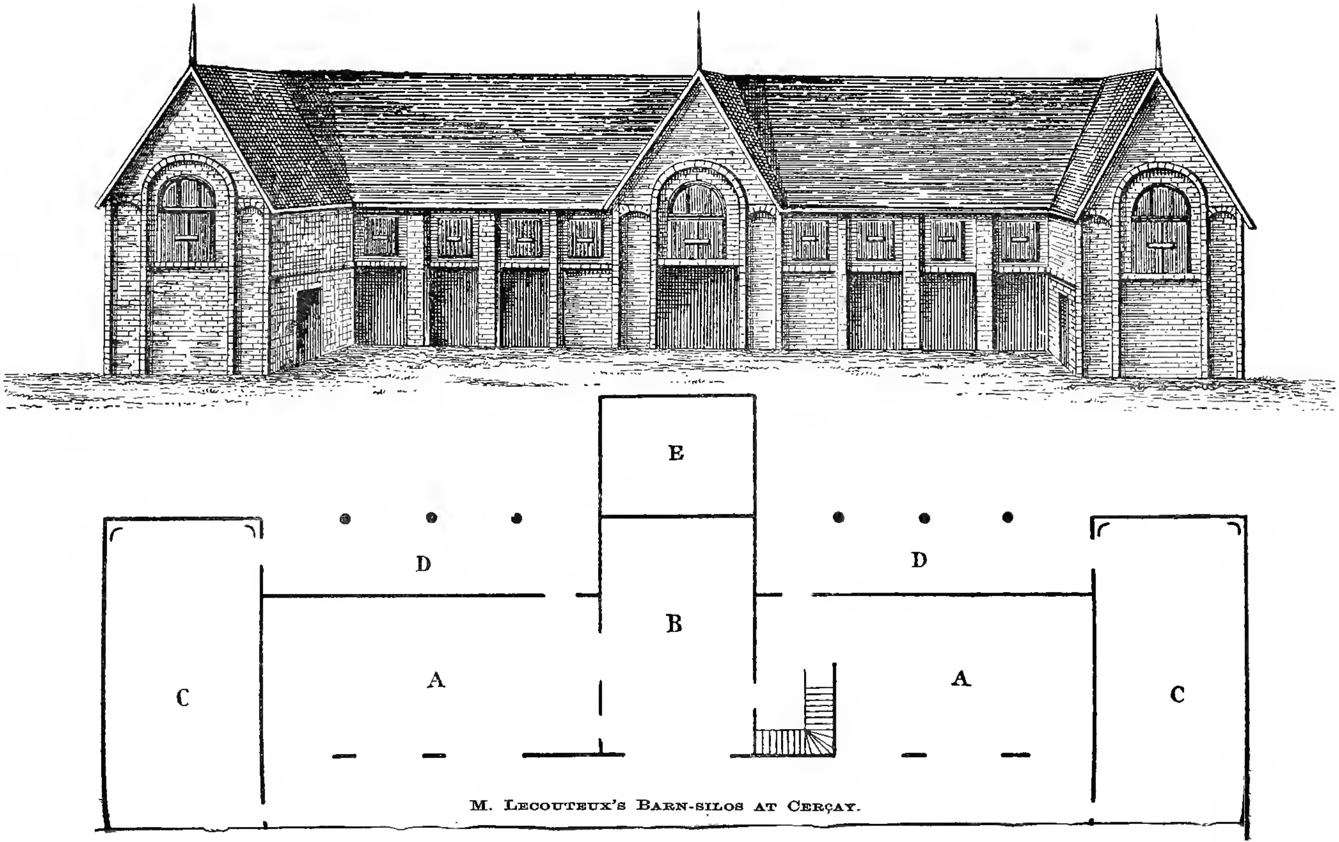
In order that the extent of Mr. Morris's operations may be understood, it is proper to add that his estate at Oakland Manor comprises about 1700 acres. His wheat crop this year (1882) was 5000 bushels, and his maize is expected to reach the same figures. The meadows yield upwards of 200 tons of hay annually. The stock consists of 50 horses and mules, 100 cattle, 500 sheep, and 50 hogs. And as the whole is managed on business principles, Mr. Morris very justly esteems his earth silos of primary importance.

The information given by Mr. Morris himself as to the construction of his silos is very brief. He says that the silo should be made in the field where the crop is grown; for the feed must be carted, and he considers that time and trouble are saved by putting it into a pit on the spot. He digs a trench "11 feet wide at top, 7 feet at bottom, as deep as convenient, and any length required," and covers up with 20 inches of earth. The soil is marly clay, and the water, he says, never comes in.

Baron Corvisart is another warm advocate of earth silos; and on his estate at Châteauneuf-sur-Cher, he stored a large

quantity of maize in 1875, for a sample of which he was awarded a gold medal at the Agricultural Show at Bourges in 1879. In reporting on this show, M. Franc, professor of agriculture at Cher, said: "Hitherto nobody has produced ensilage kept for so long a time. Four years: it is prodigious. We examined the maize closely, and can affirm that the preservation was perfect." The secret of its keeping so long appears to be simply that it was subjected to exceedingly high pressure, by the great thickness of earth piled upon it. In an article in the *Journal d'Agriculture Pratique* on Baron Corvisart's mode of practice, M. Lecouteux says: "M. Corvisart estimates that his covering of earth exercises a pressure of 4500 kilogrammes on each square metre. Neither air nor water, he says, can penetrate and interfere with its good and durable preservation." Under so great a mass of earth this is not surprising, for 4500 kilogrammes per square metre equal about 900lb. per square foot; and as a cubic foot of earth weighs from 80lb. to 100lb., one can imagine the immense thickness of soil required to produce such a pressure. As M. Lecouteux remarks, "It must not be supposed that the digging of these trenches costs nothing."

In these islands there have been several instances of earthen silos being made with success. Mr. Solomon quaintly says (page 285), "I simply dug a hole in the ground and buried my haystack;" and he is so contented with the result that he intends, for the ensuing season, to enlarge the pit, which was already 21ft. long by 12ft. wide. One that is longer and wider—30ft. by 15ft.—has been made by Mr. John Bourne (p. 254); another equally long trench, but narrower—30ft. by 9ft.—was made by Mr. Quartly (p. 241); and smaller pits by Mr. Hargreaves (p. 286), Dr. Foulis (p. 287), Mr. Oakeley (p. 314), one on Lord Seafield's estate (p. 320), and three by Mr. G. Fry (p. 351). Mr. Miller (p. 236) excavated a trench 60ft. long, which he had lined, owing to the porous nature of the soil; and probably there are many others, not here mentioned, who have experimented in a somewhat similar way.



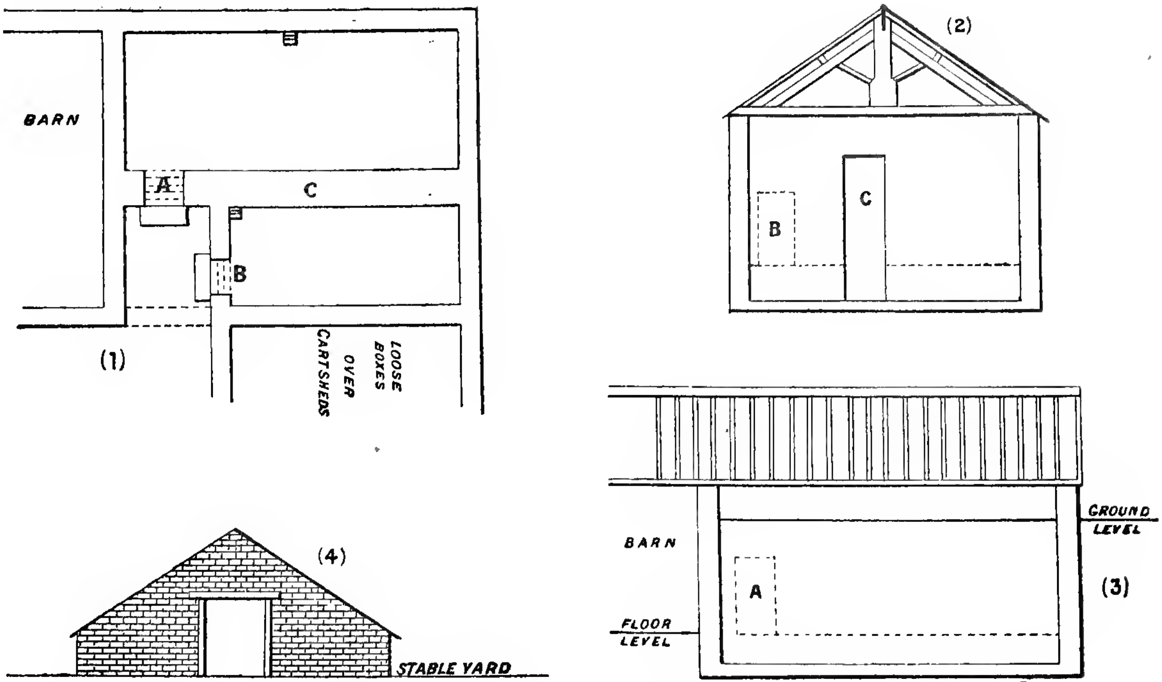
M. Lecouteux's Barn-silos at Cerçay.

Barn Silos.

Allusion has already been made to M. Goffart's conversion of an old cart-shed into silos; and the commissioners appointed by the National Agricultural Society of France reported also on M. Goffart's ready adaptation of means to ends, saying: "We have been very favourably impressed by seeing silos placed in an old disused distillery which was now supplying the cows with their daily provender. These silos are simply formed by the side walls of the building, with dividing walls about 8ft. in height. No excavation has been made, and the forage is heaped up on the soil as high as the floor above will permit. Openings have been left in the dividing walls, so as to allow of passage from one compartment to another, in order to fill and empty them in succession."

A quotation from M. Lecouteux, on p. 39, stated his preference for turning existing farm buildings to account, instead of either digging pits in the earth or building special silos. The illustration on the opposite page gives a representation of the barn silos belonging to M. Lecouteux, together with the ground plan, these illustrations as well as the following particulars being copied from his book on "Le Maïs et les autres fourrages verts."

The building has a frontage of 114ft. in length, with a height of 25ft. up to the ridge of the roof. It faces the north, and is divided into seven parts, A A being sheds with lofts over; B, site of the thrashing machine, also with loft above; C C, barn silos, the inner angles of which are well rounded. They are built of brick to the height of 10ft., the walls being 14in. thick, with pilasters 18in. wide. Above the height of 10ft. the walls in front, except in the gables, are built of wood, with windows. D is a penthouse in the rear, and E a barn for corn-sheaves. A portable steam-engine, which works the thrashing machine, is shifted to the right or left at the time of ensilage, in order to work the chaffcutter when placed close to the respective silos, CC. These are each 45ft. long by 18ft. wide, and the chopped maize is filled in to the height of about 13ft.



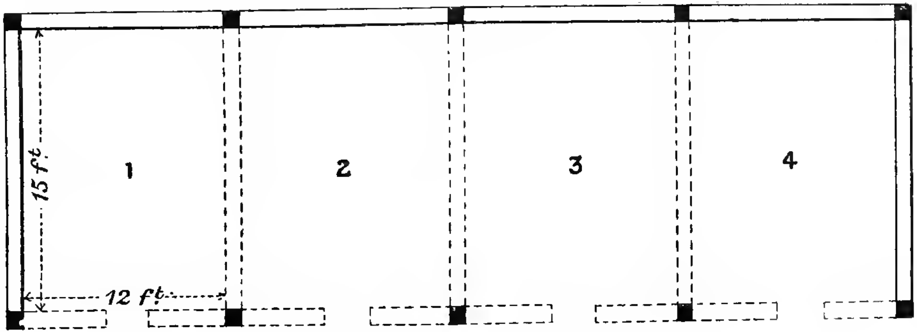
Mr. Stobart's Silo at Pepper Arden, Yorkshire.

In America the practice of converting barns, and other buildings, wholly or in part, into receptacles for green forage, has been very widely adopted.

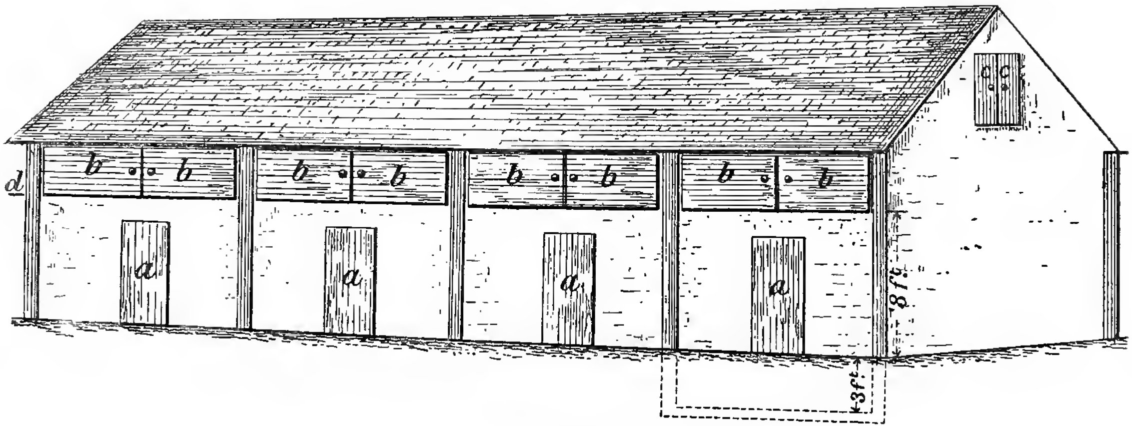
Of the number of silos as yet constructed in the British islands a very large proportion have been adapted from existing buildings of some kind or other—dilapidated barns, unused icehouses, manure pits, and various other structures being made serviceable at comparatively small outlay. One of the earliest, if not the earliest, in doing so, was Mr. A. J. Scott, of Rotherfield Park, Hants, who has carried on ensilage experiments for the past eight seasons, and who converted two cattle-feeding pits into silos at a cost of 30*s*. Lord Walsingham, in 1881, constructed a small silo in a granary, and in the following year made three silos in an old clay barn, as described at page 260. On the Earl of Wharncliffe's estate in North Yorkshire several stone barns have been converted into silos as detailed in Mr. Broderick's letter at page 216.

Mr. W. Stobart, of Pepper Arden, has had a double silo made out of a large seldom-used building in his farmyard. Mr. Easdale, the agent of the Pepper Arden Estate, has furnished the accompanying plan of the structure, which occupies an angle of the farmyard between the barn on one side and cart-sheds with loose boxes over them on the other side. The large pit is computed to hold between 90 and 100 tons of silage, and the smaller one upwards of 40 tons. Fig. 1 is the ground plan, Fig. 2 the cross section, and Fig. 3 the longitudinal section. AA, the door through which the large silo is emptied; BB, door through which the small silo is emptied; CC, the wall, 3ft. thick, on top of which the block-iron weights rest while the pits are being filled. 4. End elevation, showing the door where the grass is thrown in. Lengthy details of the experiments are given by Mr. Easdale at p. 207, and an account of the R.A.S. inspection appears at p. 298.

Sir Richard Glyn (p. 237) utilized an old sawpit as a receptacle for lawn mowings and other grass. Mr. Harris's silo (p. 238) was originally a receptacle for dung, but has been



GROUND PLAN OF THE PECKFORTON SILOS.



FRONT VIEW OF LORD TOLLEMACHE'S SILOS AT PECKFORTON

altered for the present purpose at a cost of a good round sum (100*l*.); and it now is a building 35ft. in length, 18ft. in breadth, and the walls are 10ft. 6in. high, with a slate roof.

By far the largest utilizers of antique farm buildings are the Messrs. Trepplin, who put upwards of 1000 acres of grass into their silos last year. Mr. C. Trepplin, in a letter in the *Field*, said: "You doubt the desirability of drawing off the moisture by draining from grass pitted in barns. We can speak with a certain amount of experience, as we have made some *five thousand tons* of ensilage this year, and feed upwards of three hundred dairy cows, besides other stock, on it. There is no need of either cementing or draining if barns are used. All that is necessary is to have the ventilating holes, cracks, &c., filled up. By not draining, the moisture is gradually re-absorbed again, and thus none of the strength is lost. Those who make pits for ensilage, and yet have old barns and threshing floors comparatively unused, are very extravagant, for there is no need of any expense beyond a few shillings for a bricklayer's wages in stopping the holes in the walls. If only one bay of a barn is used, the open end can be fastened up with planks." Some particulars of Messrs Trepplin's silos are given at p. 257.

Lord Tollemache is another converter of existing buildings into silos. Wishing to ascertain practically, on behalf of his tenants, what were the advantages of the ensilage process, he determined to adapt an open Dutch barn to the purpose, by inclosing and dividing it into four silos, as will be seen by the plan given in the opposite page. The building was a little over 50ft. long by 15ft. broad, and supported on ten pillars; and it was converted into four silos by bricking up the spaces between the pillars. The doors (*a*) were used for filling to a certain extent, after which the doors were closed, and screwed to the jambs, and they were eventually bricked up on the outside, so as to make them impervious to air. The shutters (*b*)—which are 8ft. above ground—were then used for continuing the filling, and those above (*c*) could finally be employed for entrance and egress when the silos had been filled to the

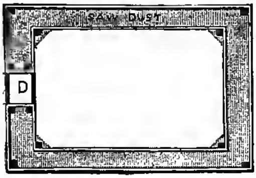
height required (*d*). It will be seen that below silo 4 there are dotted lines showing an excavation of 3ft. into the soil, which was done with a view to ascertain whether there was any difference in the quality of ensilage below ground and that above the surface, as in the other three silos.

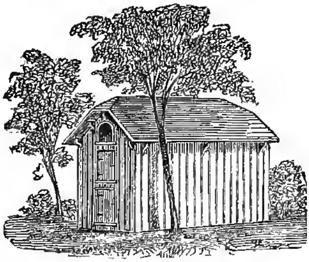
Lord Egerton had an icehouse in Tatton Park converted into a silo, as shown at page 250; Lord Harlich also (p. 341) and several other gentlemen have converted similar buildings to a more useful purpose, by storing summer crops that are always available instead of a winter crop that is seldom produced in our climate.

Among the other converted buildings may be mentioned Mr Lowe's (p. 253), Mr. Bourne's (p. 254), the Earl of Warwick's (p. 255), Lord Fitzhardinge's (p. 259), Mr. Whitbread's (p. 280); Mr. Miller's (p. 293), Mr. Eckersley's (p. 294), the Marquis of Bute's (p. 324); a disused water tank (Mr. Melrose's, p. 322); a disused gas tank (Waverley, p. 325); an old brick-kiln (Sir D. Baird's, p. 333); a coach-house and stable (Mr. E. J. Smith's, p. 335); a "turnip hole" (Sir J. C. Kennedy's, p. 337); a cow-house (Mr Lloyd-Vaughan's, p. 345); and various others.

In America a number of ice-houses have been turned into silos. It must not be supposed, however, that these are necessarily pits dug in the ground, lined with masonry, and closely shut in above, as depicted at page 250, and as is the case with most of the ice-houses in this country. In the States, ice-houses are commonly built of wood, above ground, and are left open to the air between the roof and the top of the walls, so that there would be little difference in their method of storing ice and storing fodder. In these ice-houses the walls are built of double planking, much after the fashion shown in the ground-plan for building the concrete walls of Mr. Bailey's silo on p. 59. But, of course, the joists that are there represented outside the planks should be between the boards in the wooden silo, as the inside walls of the silo should be as smooth as possible; and planed boards, placed upright, would be better than rough ones, because they would

allow the fodder to slide down more evenly and pack better—which is a very great advantage. We have not seen a representation of a wooden silo, but the following small figures of an American ice-house will doubtless afford a tolerable idea of some among those which are said to have been applied to the storage of green crops instead of the storage of ice. The window shown in the building is intended for the purpose of





ventilation, already alluded to as common in American ice-houses; but in a building specially erected for a silo it would be advantageous, for convenience of filling, to have the roof raised, as shown in the side view of Mr. Bailey's silo (page 59). The following description of the mode of making the walls of a similar structure may be interesting as showing how American farmers set to work in such matters:

Mark out your ground the size you require for the house; then, commencing at one corner, dig a double set of holes opposite each other, 1 foot deep and 2½ft. apart, on each side of the intended building, say 3ft. equidistant, so that when the posts stand up they will present a double row, 1½ft. apart. Then set in your posts, which should be of oak, chesnut, or some lasting wood, and pack the earth firmly around them. The posts should be full 8ft. high above the ground to where the plate of the roof is attached. If the posts are sawed, they may be 4in. by 6in. in size, set edgeways towards each other. If not sawed, they may be round sticks cut from the woods, or split from the body of a tree, quartered, and lined to a surface to receive the planking. Of course, when the posts are set in the ground, they are to show a skeleton of what the building is to be when completed. When this is done, square off the top of each post to a level all round; then frame or spike on to each line of posts a plate, say 6in. wide and 4in. to 6in. deep, and stay the two plates together strongly, so as to form a double frame. Now plank or board up

closely the inside of each line of posts, that the space between them shall be a fair surface. Cut out, or leave out, a space for a door in the centre of the side where you want it, and board up the inner partition sides of his opening, so as to form a door-case on each side, that the space between the two lines of posts may be a continuous box all round. Then fill up this space between the posts with sawdust, well packed from the ground up to the plates. For the roof, take common 3in. by 4in. joists for rafters; or, in place of them, poles from the woods, long enough, in a pitch of full 35° from a horizontal line, to carry the roof over the outside of the plates. Secure the rafters well to the plates by pins or spikes, and then board over.

This method of making walls is very well suited for partitions in barns, &c., when a portion is required to be divided off for use as a silo. A wooden silo, built in England, somewhat after the above fashion, but with clay filled in between the boards, will be found described at page 281.

Specially Constructed Silos.

With respect to the question, "What kind of silo is preferable?" M. Goffart said, at the Conference at Blois before mentioned :

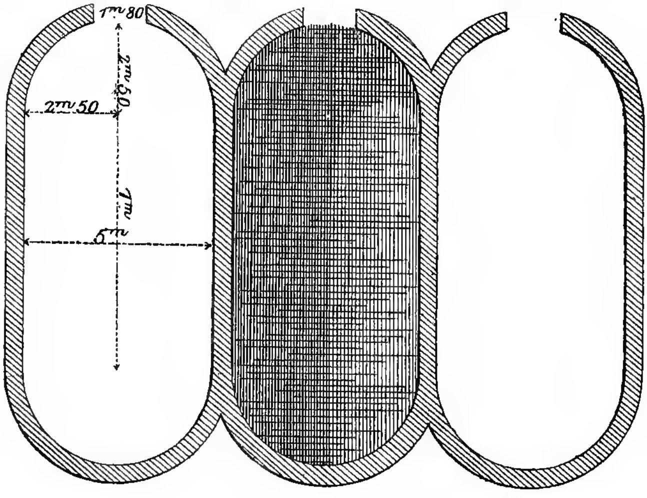
A silo on the ground level—a kind of room or chamber—is that which gives the best results during cold weather (from December to March inclusive); but as soon as the temperature rises, fermentation sets in with great energy, and in 1874 and 1875, from the month of March, a considerable settlement was seen to go on in such silos, owing to the slow combustion which took place in the mass.

The underground silo, with walls of masonry, does not suffer from this inconvenience. The temperature does not rise in them in March, nor even in April. And at Burtin the ensilage which is being taken from the silo at this time (May 8, 1875) has undergone only a slight fermentation; it is nearly in the same condition as when put into the silo seven months ago.

If I were about to commence the construction of silos, I would choose a rather elevated spot, where the ground could be dug into to the depth of six or seven feet without fear of an influx of water. I would make the silo of masonry, and carry up the walls a similar distance above ground, and thus I should have a mixed silo twelve or thirteen feet high, and seven to ten feet wide, half under and half above ground. During the winter the part of the ensilage above the ground level would be consumed, and the lower portion be reserved for the hot months, when the part farthest from the entrance would be first attacked, and the cutting

carried back towards the door. In this way, I think, excellent conditions would be obtained, suited to the exigencies of the different temperatures.

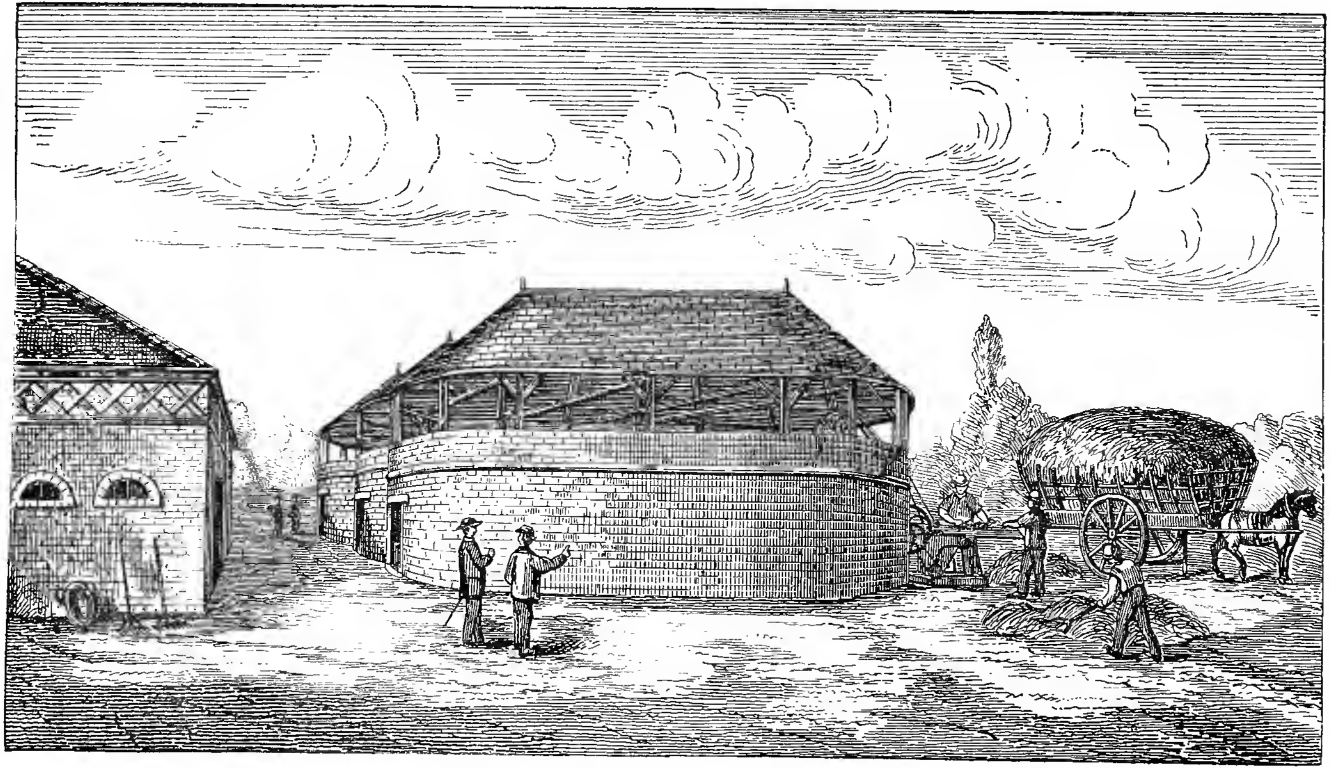
Since the time of that Congress, M. Goffart has built several new silos, together with extensive cattle-sheds immediately facing the silos, as shown in the engraving on the next page; and he has considerably enlarged his ideas with respect to the dimensions of his silos, in like manner as he has greatly increased the number of cattle which he feeds upon silage. With regard to the shape, also, he has made some modifications, and now prefers the silos to be "elliptical," as he calls



GROUND PLAN OF M. GOFFART'S TRIPLE SILO.

them—though they are not strictly elliptical, the sides and walls being straight and the ends semicircular. We give a plan of his latest construction, three silos combined together, each being 5 metres (about 16½ feet) in width, the same in height (half being below and half above ground) and 12 metres (about 40 feet) in length; about 24ft. of the walls being straight, with a semicircle at each end. With regard to this modification in form M. Goffart says:

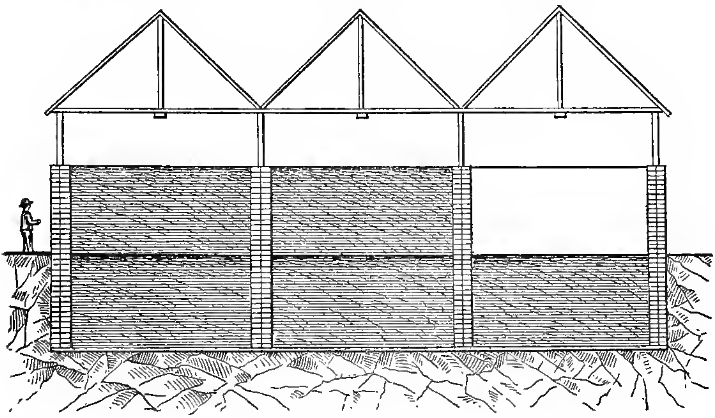
If I have greatly modified my process of ensilage, the modifications have related principally to the form, the dimensions, and above all the covering up of my silos.



M. GOFFART'S SILOS AND CATTLE SHEDS, AT BURTIN.

The form has particularly occupied my attention; it exercises a very great influence on the results to be obtained. The form ought to be that which avoids every kind of angle and offers the least obstruction to the settlement of the materials in the silo. The elliptical silo represented in the plan fulfils these conditions. All angles are done away with, and the walls being vertical (not sloping as some persons make them) offer the least possible resistance to settlement—but more than is desirable nevertheless. The elliptical form also presents another advantage, which is very valuable as regards the strength of the silos. The underground walls thoroughly withstand the thrust of the earth, which forced in the walls of my first structures, and sometimes rendered them unserviceable.

With respect to the dimensions of my silos (length, width, and height), those who have followed my doings can answer for my constant tendency to increase them, in order to obtain the greatest capacity. When you



Vertical Section of M. Goffart's Triple Silo.

must operate upon considerable quantities of fodder, and have in your cattle-sheds a large number of beasts to feed every day, you must not hesitate to give to your silos the greatest dimensions compatible with the other conditions of an easy and economical service.

Great masses keep much better than those which are small, or in other words, the preservation in small silos is always less perfect than it is in great ones, for these reasons:—However smooth the walls may be made by plastering, the fodder always lodges against them; and whatever precaution may be taken, the settlement close to the walls is sure to be more or less obstructed, and this is detrimental to good preservation. The trampling down alongside the walls may have been very carefully done at the time of filling the silo, you may have heaped on the top of the mass, alongside the walls, a very considerable quantity of heavy

weights (which is a practice that I cannot too highly commend), but the best preserved materials will nevertheless be those farthest away from the sides. Near the walls there is usually some amount of damage, and although it may not be important it is nevertheless desirable to restrict it as much as possible. This particular damage is increased or diminished according as the walls present a greater or less amount of surface in contact with the fodder as compared with the whole mass. Hence there is considerable advantage in giving silos the greatest capacity possible, as those which hold but a small quantity have proportionately a much larger surface of contact.

Suppose, for example, a silo one yard square and one yard deep; for this cubic yard of capacity would be five square yards of surface. If you multiply these dimensions by ten, and make your silo ten yards every way, you will then have a receptable of 1000 cubic yards capacity, with a surface of contact of only 500 square yards; that is to say, there would be, for every cubic yard of capacity, only half a square yard of surface, instead of five square yards as in the small silo; and you thus will have diminished by nine-tenths the evil pointed out. I need scarcely say, however, that I do not recommend silos of such proportions as these. I merely give an extreme illustration in order to render my meaning the more clear.

Fact answers but too well to the theory here set forth. I have continually found the fodder not so well preserved in small silos as in large ones. Whether the silo was great or small, I always used to find that, where the fodder came into contact with the walls, there was a layer from half an inch to an inch in thickness which had not kept well. In large silos this forms but an insignificant part of the mass, and cannot produce any evil effect; but it is otherwise in small silos, where the damage may affect 15 or 18 per cent. of the mass. Nowadays, thanks to the care which I take to put extra heavy weights on the mass close by the walls, the fodder is as well preserved there as elsewhere.

Formerly I recommended silos of small dimensions; but that was because I had not then discovered the marvellous results which may be obtained by the employment of heavy weights in establishing and maintaining density in the silos. When ensilage was taken out, the air quickly penetrated into the mass in the silo (where a want of sufficient density gave it free passage), and rapid deterioration was the result. It was natural, therefore, to endeavour to check this as much as possible; for the first effect of the penetration of air was to raise the temperature of the mass to a very high degree by continuous fermentations (first alcoholic, then acetic, then putrid) which rapidly succeed one another; and the mass being thus a prey to a kind of slow combustion, went on continually deteriorating as long as the ensilage remained in the silo. Under such circumstances it was necessary to make the silos small, and to get the contents eaten as quickly as possible. But when at last I discovered that, by maintaining a constant density in the mass, the

penetration of air was was rendered impossible, I then could abandon the small silos for others on a more important scale.

In consequence of the greater difficulty and cost of roofing satisfactorily the triple silo, M. Goffart afterwards said he should be inclined, in any future structure, to make it with two instead of three divisions, and obtain the same capacity by an increase of length. He had previously made both double and single silos with the rounded ends, so had had practical experience of their respective advantages.

In America, some writers on this subject have recommended that the silos be made rectangular, but that the corners be cut off, as shown in the illustration on page 59. This, however, is only reverting to a former practice of M. Goffart, who said in his communication to the Farmers' Dinner of January, 1876:

Having observed that the angles of my old silos constituted weak points, where the fodder did not settle evenly, and where its preservation was not so good, I replaced the right angles by obtuse angles. The inconvenience disappeared; thanks to this simple modification the angles no longer present the exceptional damage, which goes on increasing with time.

But, although he found an improvement from the corners being cut off, he found still further improvement from the ends being rounded, and hence his subsequent recommendation of "elliptical" silos.

As to precautions to be taken in the construction of silos, M. Goffart says:

Too much care cannot be taken in the construction of silos. The underground part especially ought to be the object of particular precautions. The fact should never be lost sight of that the walls have to resist two kinds of thrust, in opposite directions. When the silo is empty the masonry has to undergo pressure from the ground without; and this is especially dangerous to new walls. When the silo is full, the masonry, more particularly that which is above ground, has to withstand the pressure exercised by the ensilage, increased as it is by the weights put thereon in order to secure preservation.

Any undue economy in these constructions may have to be paid for very dearly. Nevertheless it is not necessary to slavishly follow the method which I have adopted. Instead of making all my walls of brickwork, I might, so far as regards the underground portion, have made use

of hydraulic concrete, which costs one-half less than the former; but in such case you should be very sure of your materials and workmen, which can seldom be relied on in country places.

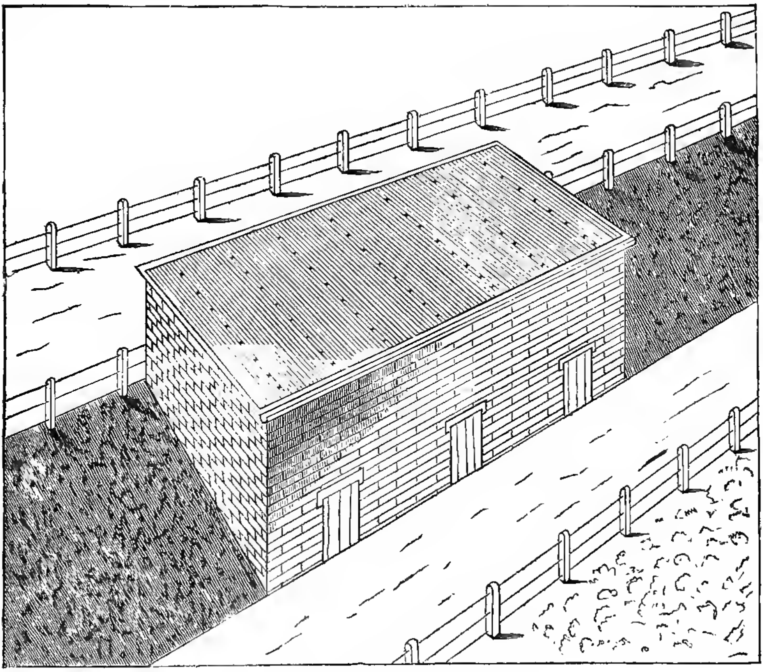
It would be an advantage for those who have a hill at hand to utilise it, so that one side of the silo should be entirely underground and the upper part of the wall be on a level with the ground by which the waggons containing the fodder could be brought up, and upon which the chaff-cutting machine could be placed, if used, so that the chopped fodder would fall from the machine into the silo. It is impossible, however, to lay down a general plan suited to all situations; the arrangements will depend upon the surface of the ground, the existing buildings which are to be utilised, the nature of the soil, and so forth.

In choosing a site for the construction of silos, it is desirable not to lose sight of the fact that their distance from the feeding sheds may have a considerable influence on the economy of labour. They should be as close at hand as possible, in order to diminish carriage; but sometimes there is an advantage in placing silos farther away, in order to avail oneself of more suitable ground.

The door of the silo ought to be at the end; because, if opened in the middle of the long wall, two surfaces would be exposed to the action of the atmosphere. The door should be closed before putting in the fodder, and this may be done by means of boards fitting into grooves in the walls. Such was the method that I first adopted; but now I close the entrance of my silos by means of temporary brickwork plastered inside with hydraulic mortar, and this wall is pulled down again at the time of opening the silo. This brickwork closes the opening much more effectually than the boards, whatever care may be taken to adjust them one upon another. Each of these openings may be closed up by a bricklayer in the course of an hour or so.

Many persons in this country and in America have availed themselves of the opportunity of utilizing the side of a hill, as well for the sake of avoiding excavation when constructing the silo, as for saving labour in filling and emptying it. Where the slope is gradual, the building is usually built with its length extending down hill; but where there is a very sharp incline, it may be convenient to build broadside on the hill, as in the case of Lord Ashburton's silos at Alresford, Hants. For particulars and woodcuts of these we are indebted to the "Bath and West of England Society's Journal" for 1883-4, in which there is an article on the subject by Mr. J. E. Knollys, including a description of the building, by Mr. T. Potter, Lord Ashburton's clerk of works. Of this we give an abstract.

Lord Ashburton has built three silos at the home farm; or perhaps it would be more correct to say one silo divided into three compartments, each 11ft. square by 12ft. in depth, the total capacity being 4350 cubic feet. The site chosen for the silo is separated from the farm buildings only by the farm road. This road is on level ground, but nearly parallel with another road on a slope leading to a rickyard on higher ground. At one point, where there is about 13ft. space between them, the upper road is 12ft. above the lower road, and between the two is a sloping bank at an angle of nearly 45°. In this space the silo is built, the top of the walls



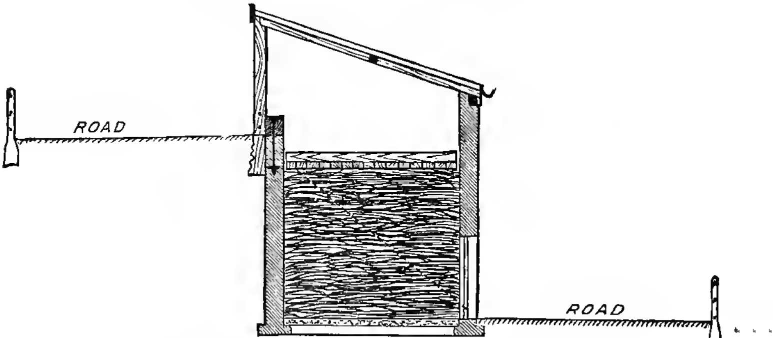
Lord Ashburton's Silos.

being level with the higher road, and the floor nearly level with the road below.

The walls are made of concrete 12in. thick, except those portions which "back" against the natural ground, and there they are only 9in. thick. The roof is of galvanized corrugated iron, resting upon wall plates front and back, and an intermediate purlin or plate, all extending the full length of the building. The intermediate purlin or plate is carried by four rafters, placed respectively over the two ends and two division walls of the silo. A very substantial roof is thus provided with a small amount

of timber, as the area is 481 superficial feet, and the quantity of timber used 18 cubic feet only.

A special mode of compression, by means of a hydraulic jack, has been applied to these silos by Mr. Potter, who has patented the invention. Particulars of the mode of application are given subsequently in the chapter on weighting. Mr. Potter is also an authority on concrete building; and persons who wish for information on this subject can scarcely do better than obtain his book on the subject, "Concrete, its Use in Building, and the Construction of Walls, Floors, &c." published by Messrs. Spon, of Charing Cross, London.

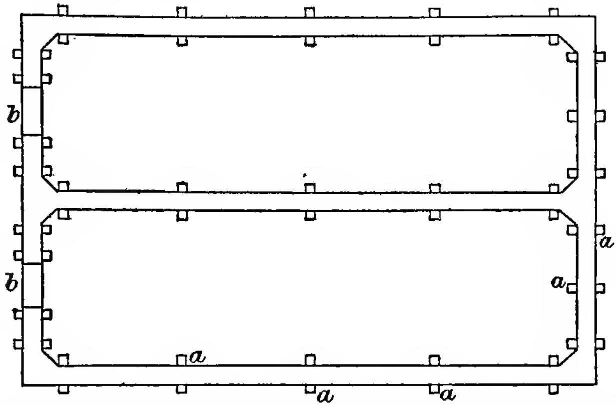


Vertical Section of Lord Ashburton's Silos.

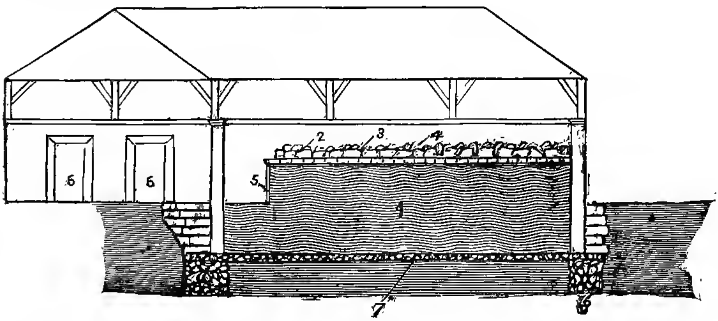
In the United States concrete is a favourite material for the construction of silos, as American farmers are very handy men, and do much of their own building work. In his "Book of Ensilage," Mr. John M. Bailey gives a plan which has some resemblance to a double silo of M. Goffart's, except that the ends are not rounded off, but have the inner angles removed as alluded to on page 55. Mr. Bailey thus describes his mode of proceeding:

Having resolved to try the experiment thoroughly, I selected a side hill, excavated on the west side and south end 7ft. deep, and put in on the west side a solid stone wall 44ft. long and 12ft. high, built of very heavy stone and in a most substantial manner. I afterwards banked up on this side to the top of the wall, making a level spot upon which to set an engine and ensilage cutter; also to drive carts upon, to deposit the fodder as it came from the fields.

I then commenced building the silo walls. These are 15in. thick, built in the following manner: First, 3in. × 4in. scantling (a) are set up at each of the angles and at intervals of about 8ft. on each side of the walls. These scantlings being placed 18in. apart, planks 12in. wide and $1\frac{1}{2}$in. thick are set up inside the scantling, leaving 15in. between the planks as the thickness of the walls.



M. Goffart recommends that the corners be rounded. I thought that cutting them off, as shown in the diagram, would answer as well and be much less expensive.



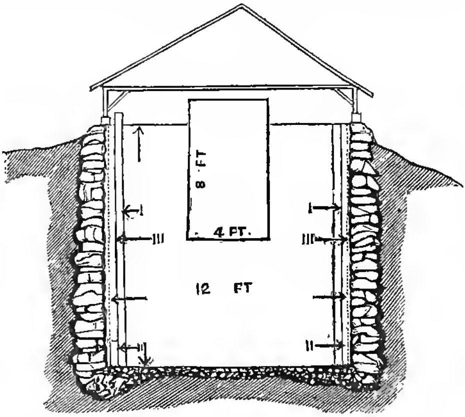
1. Ensilage.
2. Straw uncut.
3. Plank covering.
4. Stone weights.
5. Vertical slice to be taken out daily.
6. Doors.
7. Cement floor.
8. Drainage.

The concrete is made by mixing one bushel of cement with three of plastering sand and four of clean gravel. This is thoroughly mixed together when dry; it is then wetted and thoroughly mixed again, making a very thin mortar.

About 3in. in depth of this mixture is put in between the planks; then stones of all sizes and shapes are packed and bedded in this layer of concrete, after which another layer of concrete is poured in on top of this layer of stones, and the operation is repeated until the space between the planks all round each silo is filled; then the planks are raised about 10in., and the space filled with concrete and stones as before, until the walls are at the desired height. The best way is to have a sufficient number of hands to just raise the wall the width of the plank each day.

A 4in. × 12in. sill was bedded on the wall in the last layer of concrete. Upon the sill a wooden building was placed, with posts 5ft. high, the beams on the top of these posts being thoroughly braced to the posts, thus firmly tying the whole structure together.

The cost of the structure will, of course, vary in different localities, as the cost of labour and materials varies. My silos (capacity about 400 tons)



cost me about 100*l.*, or about 5*s.* for each ton capacity. Large ones will cost less, small ones more.

Silos may be built of stone, pointed with cement mortar, and plastered on the inside; or of brick, or of concrete, as mine are. Whichever material is the cheapest and most convenient in any locality is the best to use. Brick will cost more than the concrete. Concrete wall costs here about 5*d.* per cubic foot.

Large silos 40ft. to 50ft. long, 15ft. to 18ft. wide, and 16ft to 24ft. deep. are the cheapest: they will not cost more than 4*s.* or 5*s.* for each ton capacity. They require no repairs, and, if properly built, will last for ages. The cost therefore, of storage-room for ensilage is about 3*d.* per ton yearly. My plans of building silos are cheaper than to dig pits in the ground.

Small silos, capable of holding enough ensilage for ten to twenty cows can be constructed by digging and walling up, as for a cellar, when stone

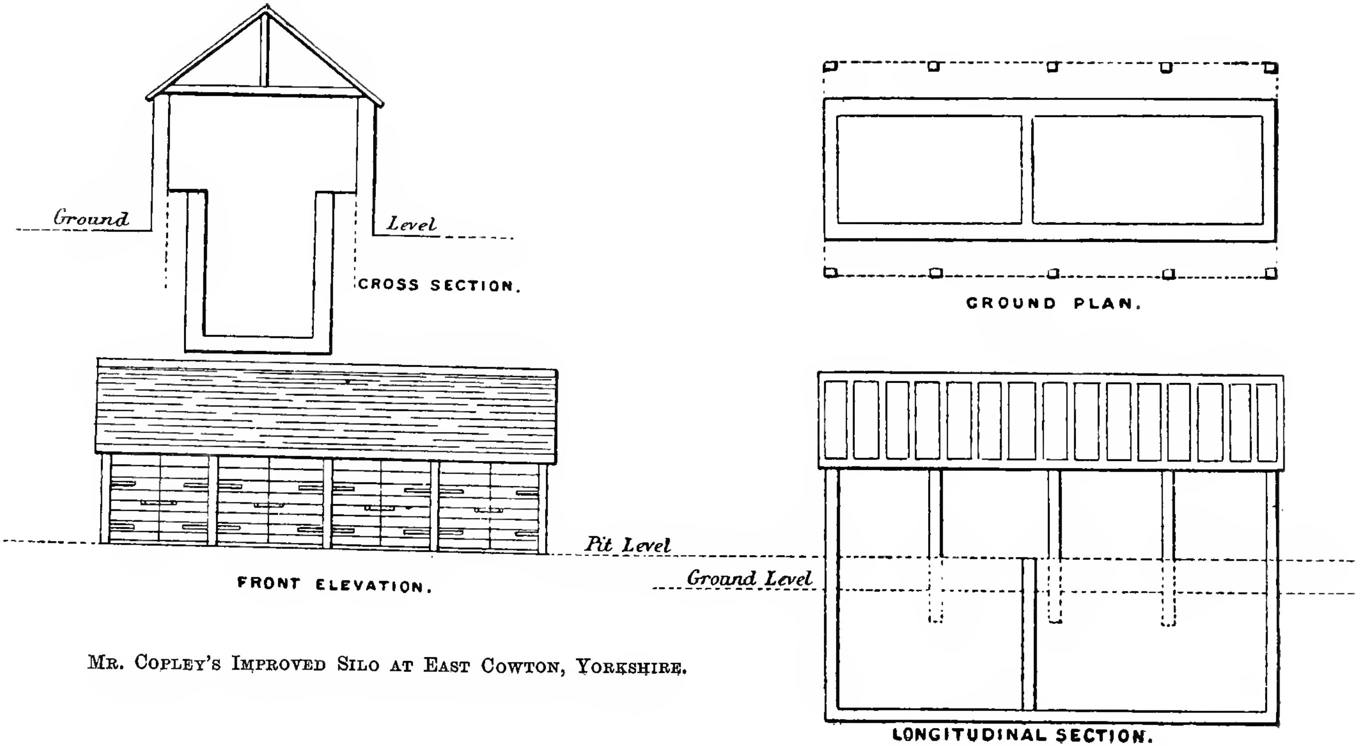
is plentiful. Mix one part cement with two parts sand, and make a concrete floor about 1in. thick. Put a cheap battened roof over it to keep the rain and snow out, and you have just as good a silo as any. One 12ft. wide, 30ft. long, and 12ft. deep would not cost, besides the labour, over 10*l.* where stone is plentiful, and it would hold enough ensilage to winter twelve to fifteeen cows.

The figure on the opposite page gives a sectional view of a small silo of this kind, I being 3 × 4in. scantling; II, 1½ × 12in. plank, between which and the rough wall a concrete or grout is poured; and III, a dotted line showing the face of the concrete pointing and plastering. A door 4ft. × 8ft. is in the centre.

Among the more noticeable of the specially-built silos in this kingdom is that of Lord Blantyre, at Freelands Erskine, near Glasgow. It is said to be like an ordinary house in appearance, being built of red brick, pointed, with a good substantial roof of slate, and, as one correspondent said, "furnished almost like a dwelling-house," with doors and fittings of pitch pine. Of course, such a building would be rather expensive, and the cost, as will be seen by the description at page 326, was more than 270*l.*

The diagrams given on the ensuing page represent Mr. Copley's improved silo at East Cowton, Yorkshire. At page 203 will be seen a description of the East Cowton silo as it existed when the first edition of this book was printed. Now its dimensions are more than doubled, by the addition of a second and larger pit; and a new roof has been erected, which extends 3ft. beyond the edge of the pit on either side, as will be seen by the ground plan on the next page. A kind of bench or platform is thus formed on both sides, which is very convenient for laying the weights on when they are lifted off the ensilage; and at other times the covered space makes an excellent shed. The building is enclosed at the back and two ends by feather-edged boards, while the front has double doors made of the same material. One of the pits is 15ft. long, and the other (the old one) 12ft. in length; they are both 7ft. in width and 10ft. deep, 8ft. being below ground and 2ft. above the surface.

Mr. Bateman (page 274) has built in Essex a concrete silo which is very similar in structure to the "Kentish Silo"



MR. COPLEY'S IMPROVED SILO AT EAST COWTON, YORKSHIRE.

designed by Mr. Kains-Jackson, and given in the last edition of this work. From the description and figures on the next page it will be seen that it is about three-fourths underground, and is covered by a movable roof, which can be taken off in sections, or run to and fro, as required during the process of filling or emptying the pit. Further details will be found in the following particulars and specification:

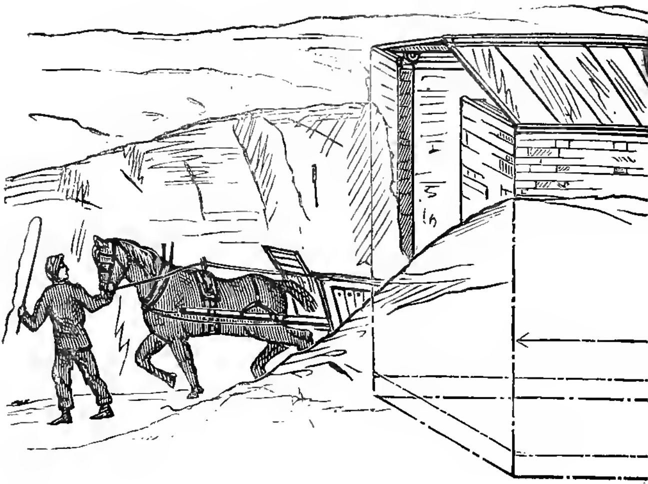
This silo—which I call a "Kentish silo"—could be conveniently placed alongside any farm roadway for ease of access, or adjacent to the homestead. Its movable roof renders it a receptacle that would serve many purposes of storage. In the specification, cost has not been spared so far as the employment of best materials, but such structures should last many generations; in fact, the "Kentish silo" would be well nigh an indestructible "farm improvement." The illustrations may be left to speak for themselves.

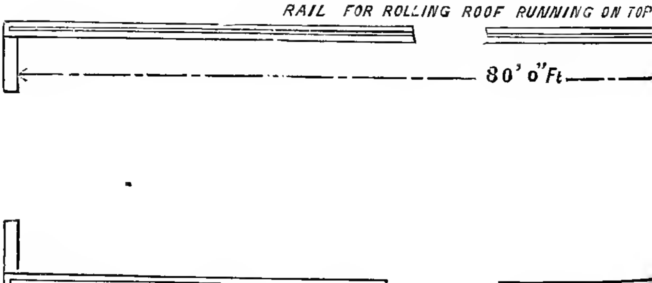
As to the cost, any country builder could give an estimate from the specification given below. The amount, as given to me by a "quantity surveyor," is not a very important one; but each district having drawbacks or facilities, tenders should be obtained in the localities where the silos have to be built. Doubtless the walls might be made of concrete; indeed, good concrete has many recommendations, but bricks or stones always form valuable materials in themselves, and are permanent representatives of the outlay, whereas "concrete" scarcely represents money, and is a substance that somehow seems to invite fraud in the making. Where the proprietor or tenant supplies the right materials and sees them properly mixed, concrete silos may be recommended.

Specification of Works required to be done in building a silo for the storage of grass, clover, and other green forage.

Excavator.—Excavate to a depth of 12ft. from the surface of the ground, to a length of 80ft. and breadth of 10ft., and cart away the soil to where directed. The earth in the foundations is to be well rammed down, so as to form a natural bed, and not made up of loose earth; sand, if found, is to be allowed for by the contractor. Excavate the earth at one end in front of silo, 30ft. long, gradually sloping to bottom of pit, as shown, if required.

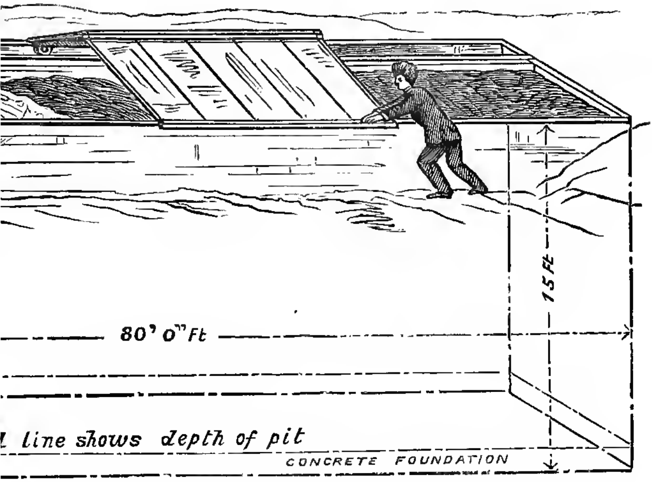
Bricklayer.—Build in Flemish bond the walls and piers of best hard well-burnt grey stocks, laid in cement composed of one part of approved cement and three of clean sharp sand, with footing of four courses of brickwork. Build in the one end of wall 15ft. × 10ft., and build a brick pier 15ft. × 1ft. 2in. on each side at other end, as shown. Lay the bottom of the pit with concrete 1ft. in depth, with a layer of asphalte 2in. in thickness on top. Form a drain in the asphalte, and concrete through





PLAN

THE KENTISH SILO.



ꟷRSPECTIVE F…

ELEVATION OF END

the centre the entire length, with a fall of 6in. from the centre towards each end, and also with a slight fall from either side of walls. Provide and lay a damp course of unbroken slates, laid, breaking joint in cement above projection of footing course. Leave a rebate at top of walls the entire length to receive the wall plate; size, 9in. by 6in.

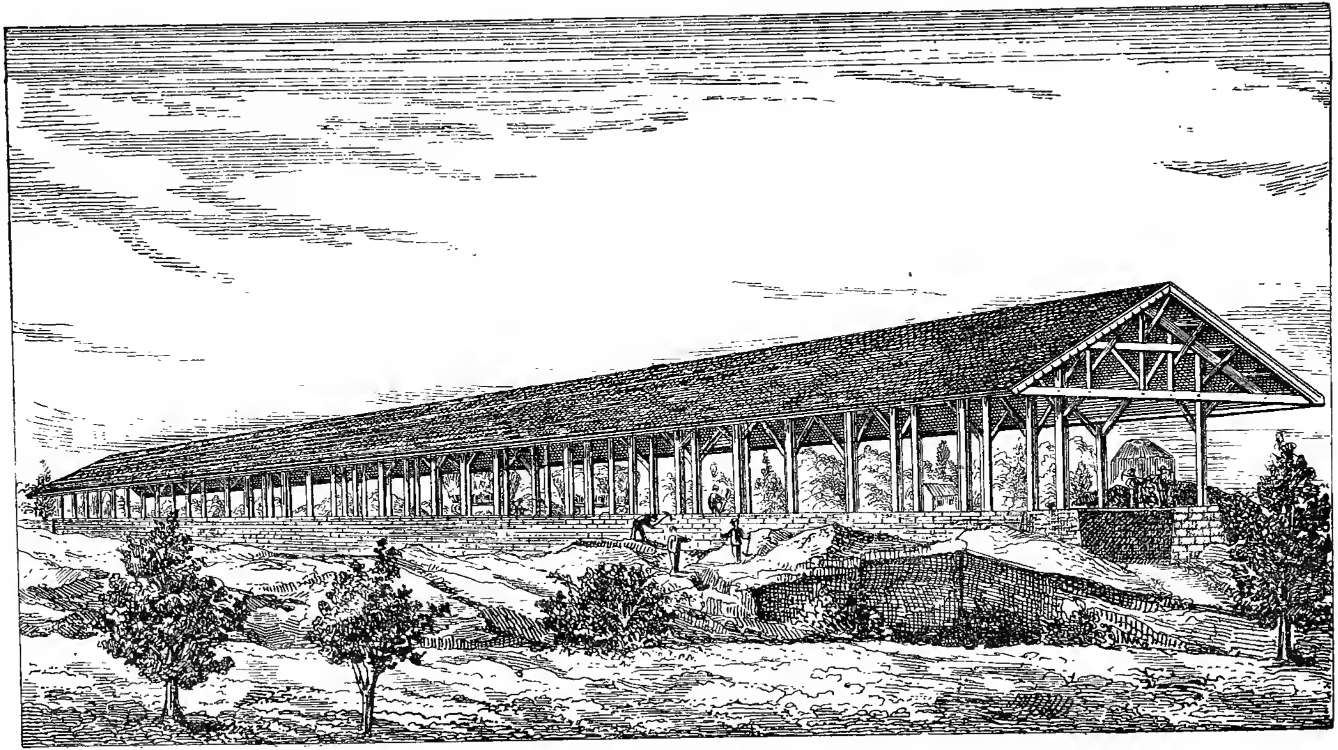
Carpenter.—Provide and fix a wall plate to run the entire length of pit (80ft.) on each side, size, 6in. by 6in., to receive the rails, and secure same firmly to walls with nails or screws; provide wood blocks for same, to be inserted in the wall.

Founder and Smith.—Provide and fix iron rails, 4in. by 2in., to run the entire length of walls on each side (viz., 80ft.). Provide eight covers, as shown, with galvanised iron roofs, 1-16th of an inch in thickness, each 10ft. by 10ft., with bearers and six rollers, three on each side, to fit rails; make same to run easily, the roofs to have a pitch of 1ft. 6in. from centre; the galvanised iron cover to be firmly joined together at ridge, and to project over the bearers and rollers, as also over the walls a distance of 2in., with a small eaves gutter on either side of the cover; each end of the cover (roof) is to be made so that, when the covers are close together, they will overlap each other slightly, as shown in the drawing, to prevent rain from drifting in.

General Remarks.—The whole of the work is to be carried out without stoppage, and to the satisfaction of the owner for whom the works are done; the materials are to be sound and good in their respective trades, and everything left complete and in good working order at finish. The contractor failing to complete any of the works commenced by him, shall be liable for the cost incurred in obtaining another contractor to finish the work, and the amount so forfeited shall be deducted from the original contract.

According to the rule given in the next chapter for estimating the capacity of silos, the structure here described would hold 240 tons of ensilage; but, of course, the length could be reduced, as thought desirable, and the capacity diminished in proportion.

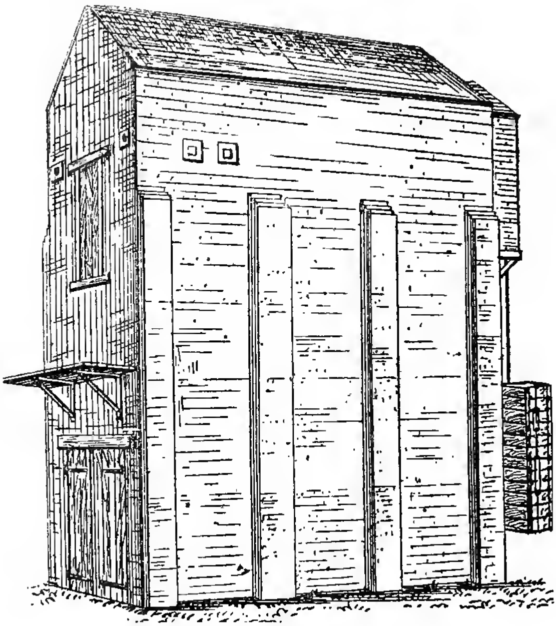
There is, we believe, no single silo in the world that approaches the dimensions of that built by the Vicomte de Chezelles, at Liancourt St. Pierre, in the department of the Oise, a side view of which is given on the opposite page. From a letter written by the Vicomte (printed at page 195, where an end view of this silo is also given) it appears that the silo is 216ft. long, by nearly 20ft. in width, and has a depth of 13½ft. The produce of 170 acres of clover and other green crops were put into this pit, and there was still space



SIDE VIEW OF THE VICOMTE DE CHEZELLES' SILO.

for more. The capacity is given in the estimate appended to Mr. Kains-Jackson's article as 1475 tons; but making the same allowance for unoccupied space as we have done in other cases, we estimate its capacity as 1200 tons. The particulars given at pp. 196—201 render it unnecessary to enter into more detail at present.

A very novel kind of silo, with lever-pressure apparatus, invented by the owner, Mr. C. G. Johnson, of Croft, is shown



Mr. Johnson's Lever-pressure Silo.

in the following illustration. The building is of brick all above ground, with slated roof. It is 28ft. high up to the eaves, 10ft. by 18ft. inside, 9in. walls, with the exception of the front end, around the doorway, which is 14in. work; and is designed to be filled to 22ft. high of ensilage, leaving the remainder for working room. The weight, which works the lever that applies pressure to the mass within, is seen sus-

pended at the further end of the building. Details of the apparatus and mode of working are given at pp. 210-215.

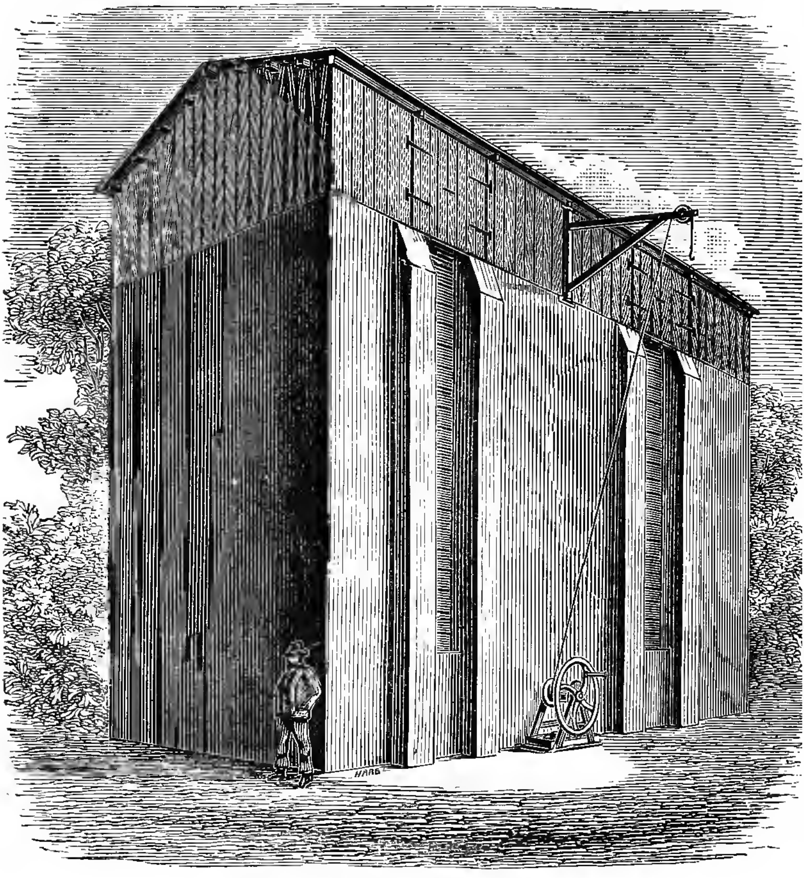
Another silo which, at the first glance, has great similarity of appearance with that of Mr. Johnson, is one constructed by Messrs. E. H. Bentall and Co., the well-known manufacturers of chaff-cutters, &c., of Heybridge Works, Maldon, Essex, who won the prize offered by M. Goffart in 1882 for the best machine for cutting up green maize for ensilage. The silo is a rectangular building of concrete, divided by a party wall into two chambers, each 11ft. square and 25ft. deep. The first illustration represents the exterior, and the second shows a section of the silo, while the following extract from Messrs. Bentall's circular gives some particulars of the arrangements.

An opening 2ft. 6in. in width (C C), which commences 5ft. from the ground level and continues to the top of the silo, is left in the middle of the front wall in each chamber. Through these openings the silo is filled and emptied. They are closed with faced concrete slabs, 2ft. 8in. wide, 1ft. deep, and 3in. thick, which fit in an internal rebate. A strong boardedf rame-work, with double doors over the openings (C C), supports the roof, raising it sufficiently to enable the silo to be worked when filled to its utmost capacity. This framework is bolted to the walls, serving as a tie to strengthen them where they are severed by the openings.

A crane, which swings between these two openings, and a winch, standing on the ground directly beneath it, constitute the necessary appliances for filling, emptying, and weighting the silo.

The crop, after being cut, is carted to a steam-power chaff-cutter, placed within a few feet of the silo, which cuts it into inch lengths. The cut fodder is then raked out of the box beneath the chaff-cutter into baskets, which are emptied into the silo, where the material is levelled and trampled down. The baskets, which are emptied by hand until the level of the opening is reached, are then hoisted up by a rope attached to the winch and passing over the crane pulley, until they arrive at a suitable height to be emptied by a man standing within the bnilding. As the material rises within the silo, the opening is closed inside with faced concrete slabs. The joints are then plastered to render them air-tight. When the fodder reaches to within about two feet of the top, it is covered with a three-inch layer of whole straw, upon which loose boards are laid so as to make a platform covering the surface within half an inch of the walls. Bucketsful of pebbles are then hoisted up, shot down, and levelled, until a pressure is attained of a hundredweight and a half to every square foot. About nine tons of stones are thus required for weighting the contents of each chamber.

When the ensilage is required for use, the concrete slabs which cover the opening are removed until the level of the covering boards is reached. The pebbles are then shovelled out of the opening, preferably into a trough leading to some convenient place where a heap may be formed for future use. The boards being taken up, the ensilage is removed in layers



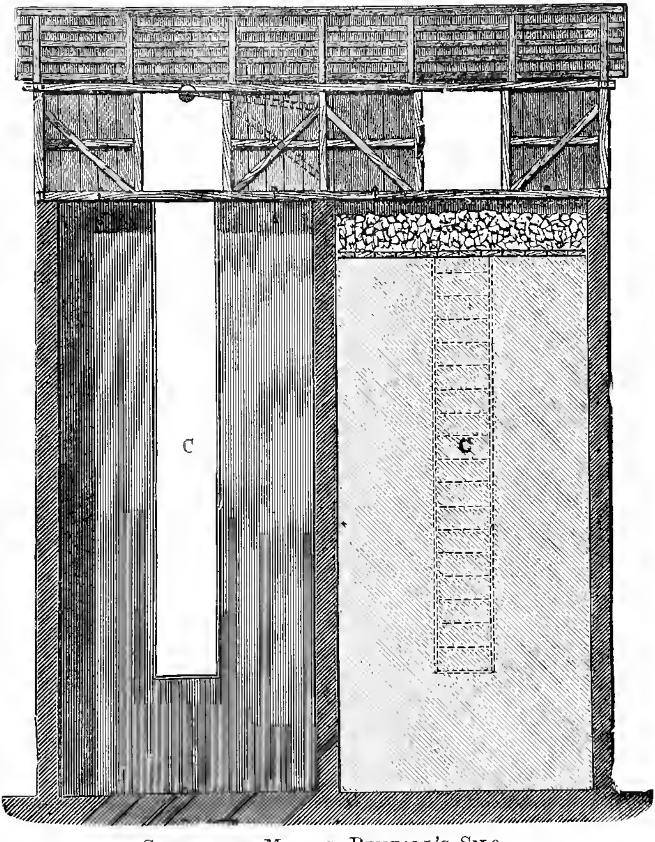
MESSRS. BENTALL'S CONCRETE SILO.

from the surface of the mass and forked into baskets, which are lowered from the silo by means of the rope and crane.

Although Messrs. Bentall prefer concrete for building purposes, having plenty of gravel at hand, they do not recommend it in preference to stone or brick for districts where those materials are the cheapest. In soils

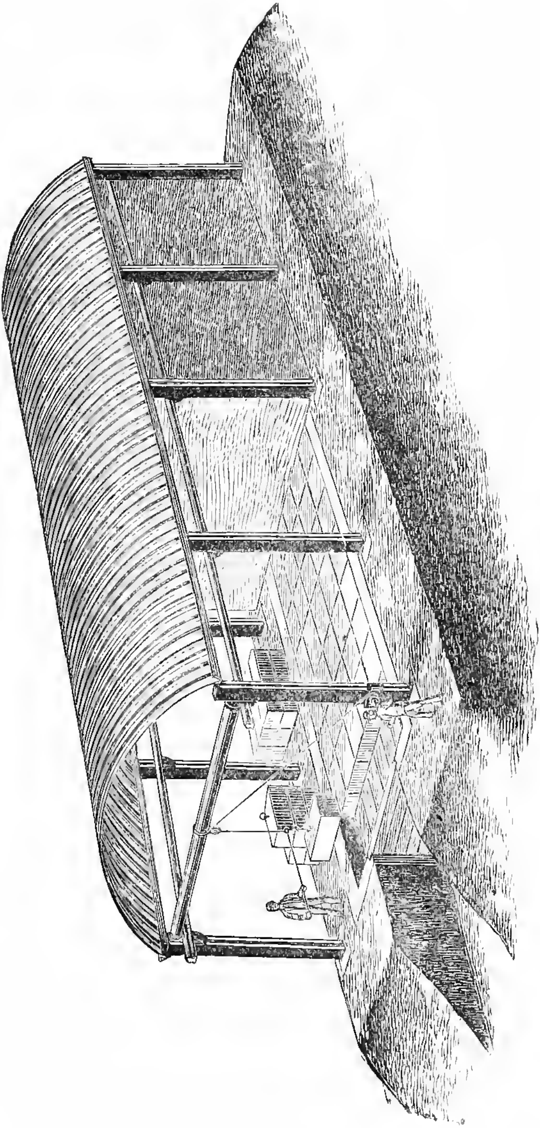
where there is no danger of an incursion of water, the silo might be built partially underground.

The foundations under the floor level are laid with slag, a material, which being impervious to water, prevents the damp from rising. The floor itself, and the walls, are made of ordinary concrete, consisting of ten parts of clean gravel to one of Portland cement. The walls which are



SECTION OF MESSRS. BENTALL'S SILO.

about 12in. thick at the base and 9in. thick at the top, are firmly bound together internally by strips of iron hooping, and are strengthened with piers on either side of the openings (C C). The interior angles are filled up and rounded off, with the view of rendering them more accessible to the men who trample down the fodder. The inside walls are truly and smoothly rendered with a mixture consisting of two parts of sand to one



Messrs. Pearson's Silo, with Weighting Apparatus.

part of Portland cement. The roof is boarded from ridge to eaves, the joints being covered with splines, which, together with the boards, are grooved so as to prevent leakage.

The accompanying illustration represents a combined silo and hay-barn or shed, roofed with corrugated iron, designed by Messrs. Thos. Pearson and Co. of Wolverhampton and Glasgow. It shows the silo filled and partially weighted, a travelling crane being used to lift the concrete or iron blocks; while the further end of the barn is occupied by hay or corn. The silo can be of any length, and from 8ft. to 20ft. in width; and the shed being made several feet wider than the pit, convenient space is available for packing weights, &c. If the contents of the pit are required before the removal of the corn or hay, it will of course be requisite to build the stack on timbers laid across the silo; and, indeed, such would be desirable in any case, unless the stack is made narrow enough to sink with the silage.

Silos of Portable Concrete Slabs.

Messrs. W. H. Lascelles and Co. of 121, Bunhill-row, London, exhibited at a meeting of the Croydon Farmers' Club in February, 1883, a silo made of portable concrete slabs, and Mr. Lascelles subsequently gave in the *Field* lengthy details of its construction, from which we make an extract.

I would make all silos portable, so that they can be shifted or enlarged, or converted to other uses, if desired. The construction should be so simple that any agricultural labourer of average intelligence can erect them or take them down. No part should be heavier than one man can lift; and the various parts should be of such a nature that they can be sent by rail, or carted on an ordinary farmer's cart, and should be stowed away until wanted, in the least available space.

Now, my method of erection is as follows: Having decided where to erect the silo, level the ground, or, if already level, place on it a raised platform of earth of about 12 or 18 inches in height, so as to keep the bottom out of the wet. Then lay down plates of ordinary 4½in. by 3in. quartering, with mortices throughout 3ft. apart., centre to centre. Insert uprights all one size—say for example 8ft. long—with a tenon each end in the plate. Drive a head plate in the top of the same length as the bottom plate, and the framing is complete. The walls are now formed by screwing slabs of concrete 3ft. long, 2ft. high, and 1½in. thick, with a hole in each corner, to the wood uprights. The screws can be galvanised if desired. The joints can be formed by a piece of tarred cord laid in as

the work proceeds, or a rush as used by coopers will do as well. These slabs can be procured from W. H. Lascelles and Co., 121, Bunhill-row, at 4*d.* per superficial foot, as advertised. They weigh about ¾cwt. each, can be sent by rail or road any distance without packing, and can be stacked outdoors. They are water, fire, and frost proof.

The general appearance will be something like the sketch (Fig. 1); I have indicated thatch for the roof, which might be reed, heather, straw, or whatever is cheapest and handiest. Boards, tiles, or slates will do where thatching material cannot be obtained.

The wood framework, before the concrete slabs are screwed on, will have an appearance something like that shown in Fig. 2. It consists of deal, all of one size (4½in. × 3in.), the horizontal plates all mortised 3ft. apart, centre to centre, each mortise being 3in. by 1in., and quite through the plate. By this arrangement the plate can be bought all ready with the mortises made; any length will come in; it can be kept in stock and cut off as it may be wanted. Fig. 3 is a sketch of this plate.

The vertical pieces are the exact height of the silo side, whatever may be found most convenient. I have taken them at 10ft., and they have a tenon each end 4½in. long, 4½in. wide, and 1in. thick, as shown by Fig. 4. These uprights or vertical pieces should be all alike, so that they, too, like the plates, could be kept in stock; and the putting up the wood framework of a silo would become as simple a matter as putting up the shutters of a shop.

The corners I would arrange as shown by Fig. 5. By this contrivance, the necessity of having special corner pieces is avoided. It will be noticed that I have shown an iron square at the corner. I would have three of these at each corner, about 12in. each way, of wrought iron, say 2in. by ½in., with four 3in. by ½in. coach screws in each square. The centre one might be somewhat shorter.

The sill-plate I would keep up from the ground by putting blocks of stone or broken slabs under it, to protect it from the wet; and the lower edge of the bottom slab should be rather below the bottom edge of sill plate, as shown in Fig. 6.

A more simple, but less neat-looking plan to form the walls of silos will be to use the quartering without mortising and tenoning, simply bolting or nailing the joint, as in Fig. 7. I have shown a 6in. ⅝ bolt, cost about 3*d.*, but two 5in. wrought nails might be used instead. Although this plan is not so neat-looking as the one first described, it is really more scientific, and it has the great advantage of saving one portion of the process necessary, and thereby reducing the cost, and at the same time increasing the strength of the structure.

To tie the structure together, I have bored holes through the plate and tenon, through which oak pins should be driven; and, about 6ft. or 9ft. apart, bolts should be carried across the silo as tie-rods, both at the top and bottom, with a nut at each end.

Although I have specified the uprights as 4½in. by 3in., the size can

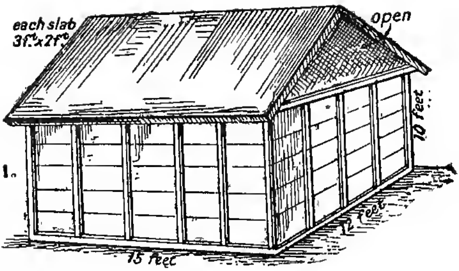


FIG. 1.

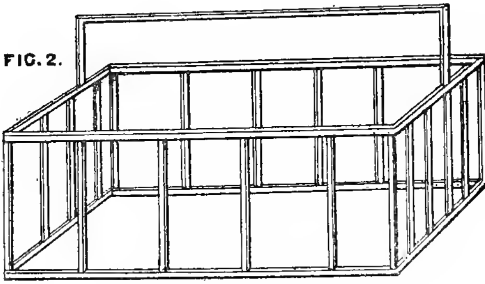
FIG. 2.


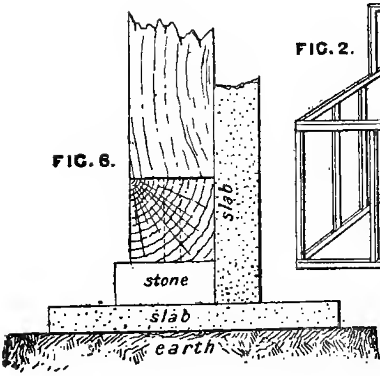
FIG. 6.


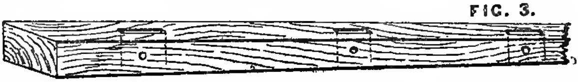
FIG. 3.



FIG. 4.

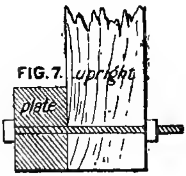
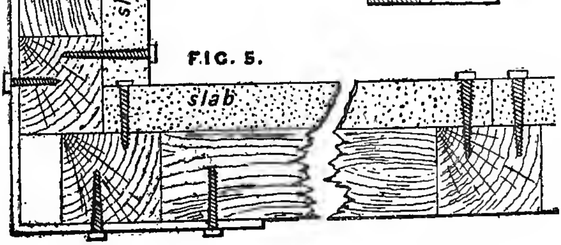
FIG. 7.


FIG. 5.


be increased if found necessary. A 9in. by 3in. deal, with the edge towards the slab, for great silos, or where much pressure is expected, would be better; or iron might be used instead of wood, without affecting in any way the principle of construction.

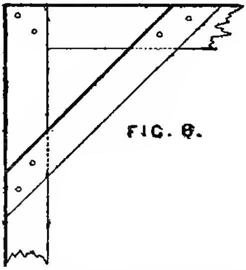


FIG. 8.

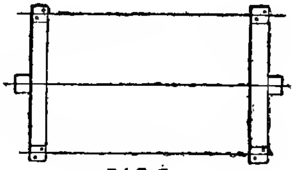


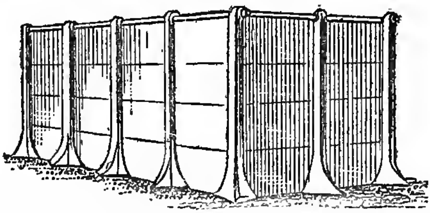
FIG. 9.

A corner-tie, formed by a piece of quartering (Fig. 8) halfened down on the top and bottom plates, would stiffen the structure, and could be used in many cases instead of the iron squares; and an additional tie-rod with plates could be added to the centre of the silo walls (Fig. 9).

Messrs. Lascelles issue a pamphlet, which can be obtained on application, giving fuller details on various points. Particulars with respect to experiments made last season with these silos will be found at pp. 288-291.

Slate Silos.

Messrs. Joseph Brindley and Co. Limited, of 61, King William-street, City, a well-known firm of slate merchants, suggest that slate would form an excellent material for silos,



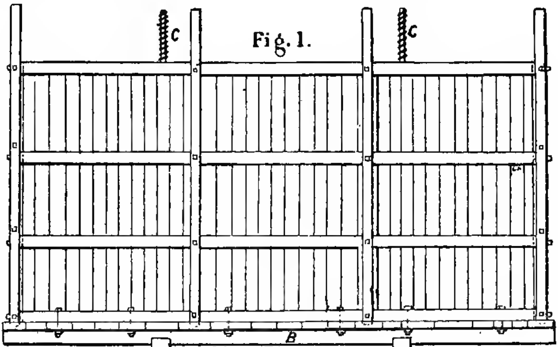
as being "cleaner, sweeter, cheaper, and more durable than any other similar material," and have patented a silo as shown in the accompanying illustration. It is constructed of wrought-iron standards fitted with grooves into which slate slabs slide, the joints being made air-tight by oakum, and the standard kept together by iron rods. If out of doors,

they suggest that it should be sunk a few feet in the ground and covered with a light roof of corrugated iron. The advantages claimed for this silo are, that it is imperishable, being constructed entirely of iron and slate; that it is easily put together, as all that has to be done is to fix the supports and slide the slate slabs into the grooves in them, which can easily be done by any unskilled labourer; that it can with equal readiness be taken to pieces and removed; and, lastly, its cheapness; but the price we have not seen stated.

Patented Wooden Silos.

Mr. S. H. Stocks, of Cleckheaton, near Normanton, has patented a silo and press of which the following are particulars:

Fig, 1 is a side elevation. Fig. 2 is a plan of top when filled and press applied. Fig. 3 is a transverse section, and Fig. 4 a longitudinal section, and Fig. 5 an end elevation.



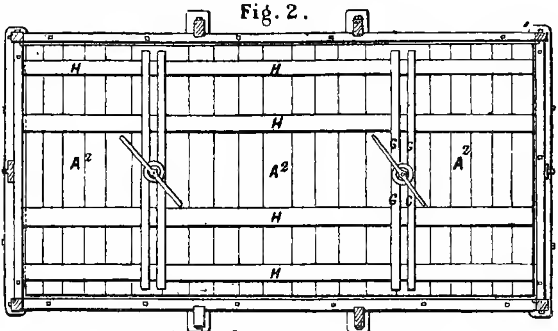
Side Elevation.

A A is the silo chamber, A^1 A^1 are doors (by preference provided). The covers of the chamber, A^2, are 11in. by 3in. or 9in. by 3in. planks; these are laid separately on the contents after the chamber has been filled.

Beneath the transverse planks forming the bottom, a longitudinal beam or beams (B) is laid, by preference of iron. C C are the rods or ties; they are secured at their lower ends to the beam (B) by screw nuts. The upper end of each tie or rod passes through the cover; D D are volute springs surrounding the ties or rods; these springs will each support a load of six or seven tons. The upper ends of the rods have screw threads cut upon them, and E E are nuts working upon the screw threads; F F are plates on which the springs stand, and F^1 F^1 are washers; G G are

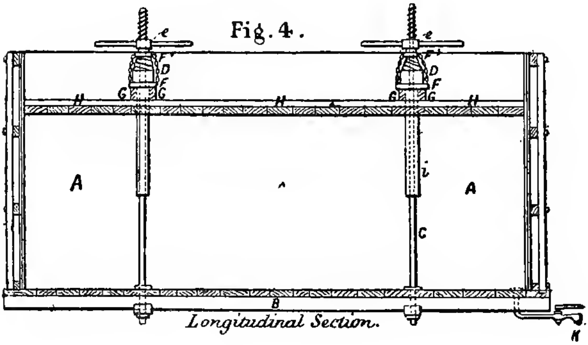
cross pieces of timber on which the spring plates rest, and these cross pieces bear upon stiff longitudinal timbers H H; *i i* are metal tubes to

Fig. 2.



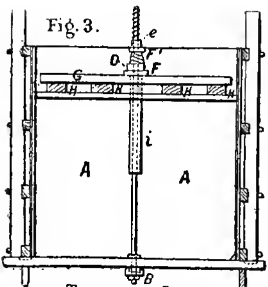
Plan of Top with Cover

Fig. 4.



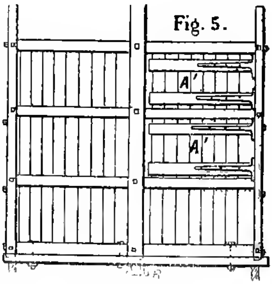
Longitudinal Section.

Fig. 3.



Transverse Section.

Fig. 5.



protect the screw threads on rods. K is a tap which may be provided to draw off the juices.

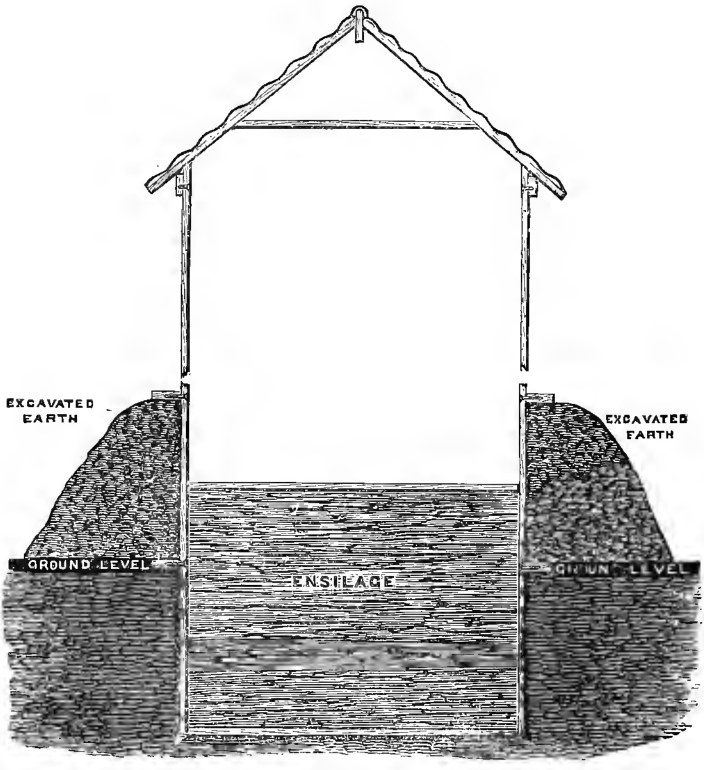
After filling the chamber with the green material to be preserved, the cover is laid as indicated by the drawings, and the screws are turned by levers until the springs are compressed. It is necessary to turn the handles once or twice during the first day or two in order that the pressure may be maintained.

When the preserved material is required for use, the silo is opened only at one end where the doors A^1 are placed. Two of the planks of the cover are taken off; to admit of this the pressure is relieved for the time, and when the planks have been got out, the nuts are again screwed up tight. In this way the material may be worked out as required, and the only exposure to air will be at the face when the fodder is cut for use.

The foregoing sketches represent a wooden silo, but the apparatus is also applied to corrugated iron silos, concrete, &c. Samples of oats, clover, and grass, preserved by Mr. Stocks in one of his silos, were in very good condition when sent to the *Field* office, and some butter, the produce of his silage-fed cows, was excellent.

Messrs. Churchton and Co., of 49, Queen Victoria-street, London, have patented a mode of constructing wooden silos, for which they claim extreme simplicity and ease of erection, with facility of removal, if required, and state that they are only about half the cost of masonry or brick silos of equal capacity. They are formed of yellow deal planks and battens, and all the parts are numbered and marked so that they may be put together by ordinary farm labourers, under the superintendence of the master or a foreman. A rectangular frame, 12ft. long and 8ft wide (or larger as may be desired), is laid upon the ground, and the soil dug away from the interior to the depth of 5ft; upright battens, 10ft. in height, are fastened to the inside of the frame, and rest against the 5ft. earthen walls of the pit, and the soil that has been dug out from the centre is piled up outside the upper half of the battens, so as to form a raised bank round the portion of the silo that is above ground-level. The principal parts of the framework are made of timber either 11in. by 3in., or 9in. by 3in., dimensions which are estimated to be capable of resisting both internal and external pressure, while the sides, tops, and bottoms vary from 1½in. to 2½in. in thickness.

Of course the purchaser of silos of this character would have to take into consideration the probable duration of the material, and other circumstances attendant on their use, such as the nature of the ground, &c.; for in some localities, with good sound soil, no drainage might be necessary, whereas in others 5ft. of soil could not be dug out without coming to

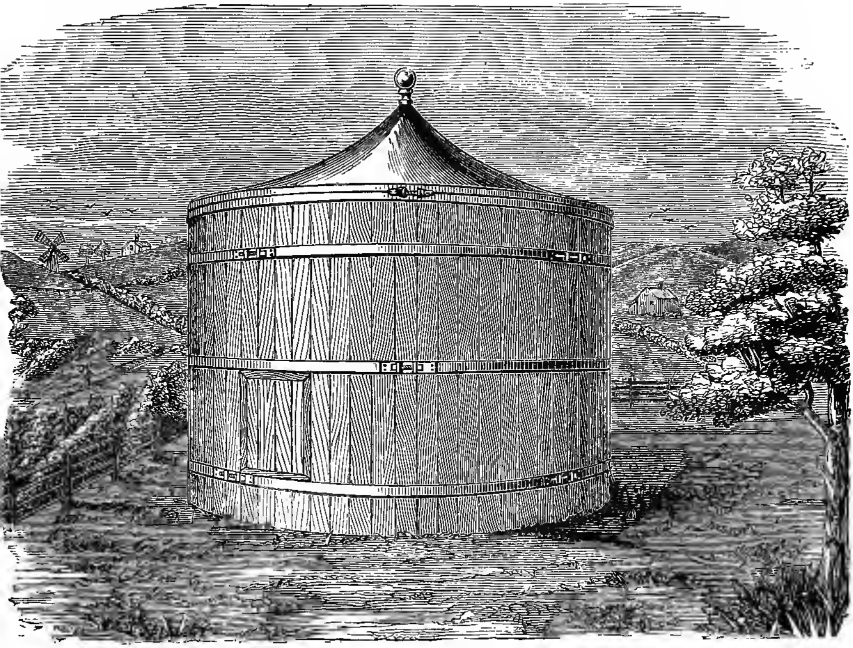


CHURCHTON'S WOODEN SILO.

water, and the woodwork is not caulked or rendered water-tight. By a modification of the process, however, these silos can be built wholly above ground; but stronger timbers require to be used, and the cost is accordingly somewhat increased.

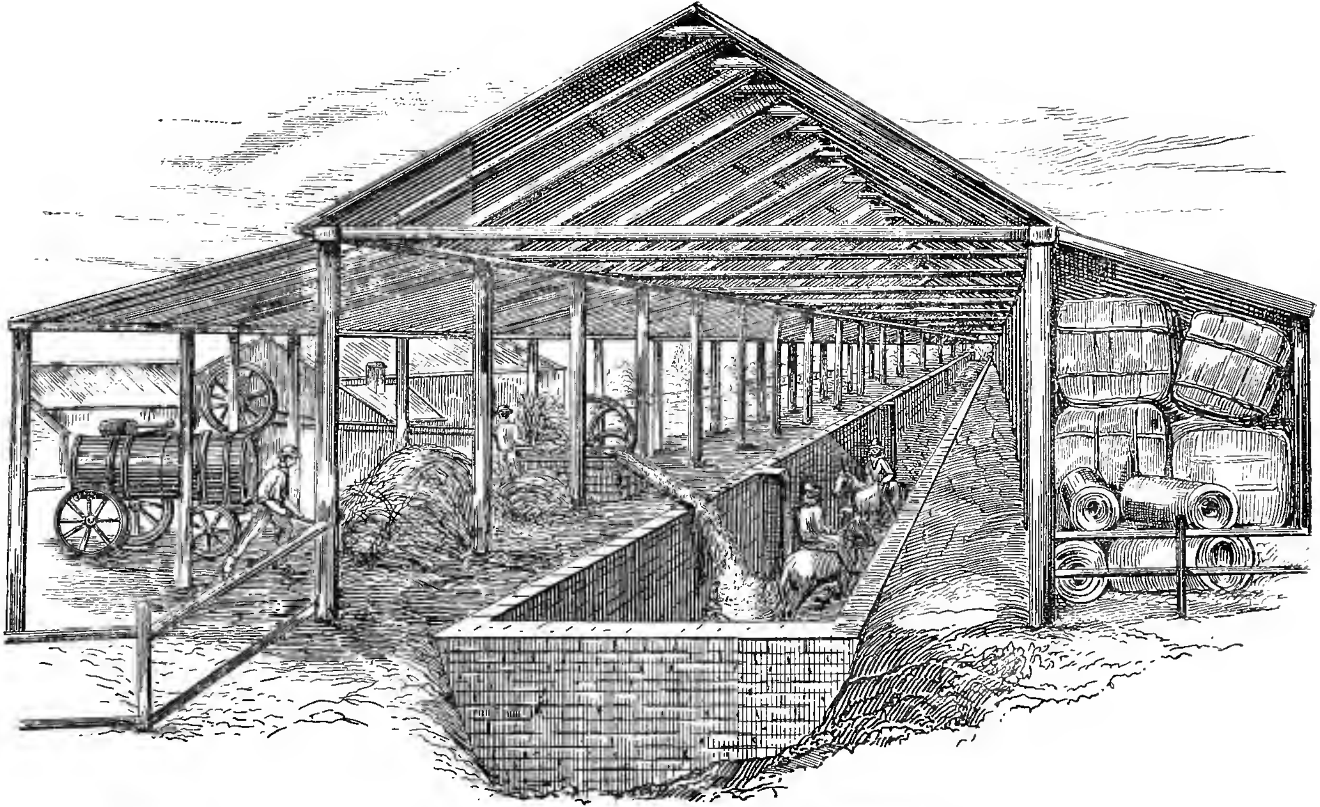
Messrs. F. W. Reynolds and Co., Acorn Works, Edward-

street, Blackfriars-road, London, have patented a new form of silo, which is represented in the accompanying illustration. It consists of wooden boards planed on the inside, and jointed to suit the radius of the required circle. These boards are erected vertically like staves of a barrel, and are held together on the outside by iron bands, which are tightened up by lugs and screws ; the bands being in sections. Some of the staves



REYNOLDS'S WOODEN SILO.

are supplied with staples, in which the bands rest before they are tightened. These staves are erected first, and, after the bands are placed in position, the remaining staves are put in a circle inside the bands, and the whole drawn together by means of the screws. A door is supplied, as shown in the illustration, to facilitate the removal of the contents. The roof consists of a cross-beam of timber, with a timber upright in the middle, the whole being covered with rot-proof and



Mr. Lamb's Silo at Rooty Hill, New South Wales.

water-tight canvas, fastened down to the sides of the silo by a band, drawn together with a screw. The patentees claim for this silo that it is practically air and water-tight, and that its form enables it to resist internal pressure, besides being best adapted for the sinking of the ensilage; and they state that the whole structure may be erected in about an hour, and removed in less than half that time.

An Australian Silo.

The illustration opposite gives a representation of a silo erected by Mr. Walter Lamb, of Rooty Hill and Merilong, Liverpool Plains, New South Wales. Mr. Lamb, having been well satisfied with the ensilage of 26 tons of fodder, on which his stock were doing well, has had silos constructed at Rooty Hill to hold 1700 tons, and intends to ensilage about 10,000 tons on his estate at Merilong. The *Sydney Mail,* from which the illustration is copied, says :

The silo which our artist depicts as in the course of being filled, is under a large hay-shed. The silo is 67ft. long, 9ft. wide, and 10ft. deep, almost entirely sunk in the floor of the shed. The sides and one end are lined with brickwork 9in. thick, not cemented. One end is completely open, but so made that it could be closed by slabs, and in the centre there were projections so that a partition of slabs could be made. Thus this long silo could be converted into two. A slight slope in the rock bottom afforded drainage. The excavation and brickwork of this silo cost about 43*l*. A similar excavation if lined with ordinary wooden slabs would entail the expenditure of 27*l*. At the time of our artist's visit it was being filled with green maize, a poor crop consequent upon the late droughty season. A portable engine of eight-horse power was on the bank, driving a chaffcutter, which was cutting the stuff into half-inch stuff as it was brought from the field by bullock teams. When the bottom of the silo was covered to a depth of 2ft., a horse was ridden through the stuff, so that it might be well trampled. Mr. Lamb has placed this silo under the shed simply as a matter of convenience. Hay may be stacked on top of it if necessary. In the case of the larger silos which will be made at Rooty Hill and Merilong, the covering will be of the simplest and least costly character. He intends to prove to his fellow pastoralists that with the ensilage made from natural grasses saved in a good season, stock in a bad one can be saved from starvation, in fact, kept fairly well for a year at the cost of 8*s*. 9*d*. per bullock, and 1*s*. 9*d*. per sheep. The weighting is done with earth; and by placing a frame on the top of each

silo he will save the cost of labour incidental to filling up the silo after the shrinkage of the stuff. Mr. Lamb uses no top covering between the ensilage and the earth. The bottom of his silo is the natural rock.

At the estimate, as in other cases, of 50 cubic feet to the ton, this silo would be of 120 tons capacity, and the cost little over 7*s*. per ton. Considering the high price of labour in the colony, this seems a very reasonable figure.

Ensilage Stacks.

In the last edition of this book was inserted a letter giving a description of an ensilage stack alleged to have been made in an open Dutch barn by Mr. Van der Breggen in Holland; but it has since transpired that the writer of the letter was mistaken on one point, for although a stack of green grass had been built up in a Dutch barn, it was not an open one, as the space between the posts had been boarded up, thus turning the open barn into a closed wooden silo.

Other attempts have, however, been made to dispense with walls, and M. Cormouls-Houlès, secretary of the Agricultural Society of Mazamet, Tarn, in the South of France, gave in French agricultural journals, in October last, the following particulars of an experiment he had carried out:

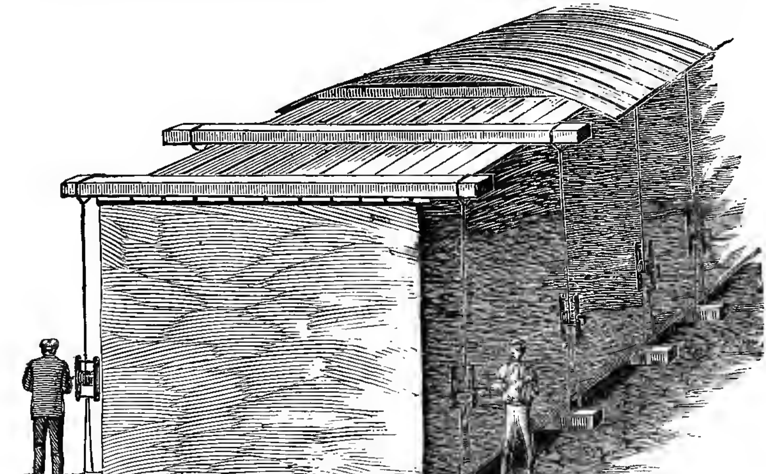
Taking our idea from an American agriculturist, and wishing to avoid all the precautions and silo building expenses that seemed to us superfluous, we placed last spring, some thirty cartloads of fresh grass and rye upon the earthen floor of a shed on the farm at Montlédier. The mass was about 12ft. square and 13ft. high. Four days were employed in making this stack, on the top of which was placed planks loaded with stones, creating a pressure of about 260lb. to the square foot. The sides of the mass reached the walls of the shed, but the two ends remained exposed. These were pared away and made trim. The compression of the weights reduced the bulk, in less than a month, from four yards to as many feet, subsequent shrinkage being scarcely noticeable. Decomposition soon showed itself on the exposed ends, and caused such a disagreeable smell that, for the moment, we thought our experiment would be a failure; but the silo is now opened, and a careful examination of the compressed forage has shown that the first vertical cut was, as we expected, entirely decomposed for 6 to 8 inches. The top surface in contact with the planks was scarcely changed, and only for a couple of inches.

Beyond the first vertical outside cut, the interior mass, perfectly

homogeneous and impermeable to atmospheric influences, had undergone a most regular fermentation, had become solidly compact and of a yellow-green colour, giving a sugary, alcoholic smell; it was in perfect preservation, having a temperature 40° to 45° C. (104° to 113° Fahr.) and when offered to the cattle of the farm they ate this ensilage greedily, and in preference to the best hay. Since the time of opening, a regular portion has been taken daily, without losing any of its appetising qualities.

Our regret is that the experiment was made on a small scale. We shall make another, after a brief delay, and are confident we can easily reduce the loss in the sides exposed to the air.

Messrs. Pearson and Co., of Wolverhampton and Glasgow, represent, in the accompanying illustration, a simple con-



trivance for compressing ensilage stacks by means of winders at the sides. Beams and planks are laid on the top and at the bottom of the stack, and, as the compressors are portable, they can be taken to the stack wherever it may be most convenient to build it. A light corrugated iron portable roof is provided by Messrs. Pearson, from whom particulars as to cost may be obtained.

The Rev. C. H. Ford, writing in the *Field*, gave the following particulars of an experiment carried out in the county of Durham:

Mr. Coltman, of Hardberry Hill, near Middleton in Teesdale, last summer made a frame as follows: He let four larch poles into the ground, so that 12 feet were above ground, in the open air. He thus inclosed 7ft. square; to the posts he nailed slabs of wood 1½in. thick, leaving an interval of 6in. between the slabs. Fourteen loads of inferior grass were stacked within this inclosure, which were estimated to weigh about 8 tons. The top of the grass, well trodden, was covered with boards. Ashes were laid on the boards, and on the boards were evenly distributed about 3 tons of clean river stones. The stack was not even thatched. The ensilage, when cut into, was found to be moulded all round the sides to the depth of 6in.; on the top, under the boards, 3in. It was of a brown colour, of good quality considering the coarseness of the material, and was greedily eaten by his cows; and so well did they milk on this food that, when it was consumed, he purchased a ton of ensilage at 30*s*. of Mr. Bainbridge of Middleton, and led it four or five miles up a very hilly road to his place, and, mixing it with bad hay of his own to spin it out, consumed the whole.

We give the above particulars about ensilage stacks, but without recommending their adoption; for we think it very probable that an insidious amount of waste goes on of which the mere external decay affords little evidence. Good palatable provender may be produced, to a certain extent; but this is not the sole test of economy, as will be explained in the chapter on Fermentation in the Silo.

Ensilage in Barrels.

The packing of grass and other herbage in barrels has excited the attention of many persons as an easy method of ensilage, and it has been practised with more or less success for a number of years. At the National Agricultural Convention of America, held at Chicago, in February, 1883, Dr. J. T. Smith said: "I got this ensilage fever about fourteen years ago. It originated in Vermont by a man of the name of Brown, who put green hay in a barrel, and tramped it down solid, headed it up, and kept it for three months. Ever since that, every article that I have seen on the subject of ensilage has very much interested me."

Barrels, from their shape, are not convenient for packing green fodder, as when it shrinks, there must be cavities left at the curvature of the staves; and the capacity being so small,

the amount of damaged fodder is likely to be proportionately large. Professor Wm. Brown, in his report on experiments at the farm of the Ontario Agricultural College, says:

We considered it would be a good thing to be able to show that live stock can be fed on green fodder either when importing from, or exporting to, Great Britain—summer and winter. For this purpose we took ordinary sized oak barrels, as also larger barrels, such as are used for beer, and lastly a very large oak tun—capacity 60 cubic feet. We found it very difficult to fill a barrel solidly round the edges with screw power, as the material tends towards the centre and leaves empty space adjoining the circumference, even when the fodder is in inch lengths. Thus we had to pack with the hand and lever power in addition to the screw. This was the first trial.

The second consisted in the same size of barrel, but fitted inside with a square box, so as to allow of the screw pressure being equal on all parts. This necessarily diminished the capacity for fodder, as vacancies remained between the box and barrel. In order, therefore, to obtain an ordinary barrel capacity along with the inside box, a larger barrel was employed as our third example; and, still further to insure success, the vacant spaces were packed very solidly with earth—earth being also placed beneath the box and on top of fodder when finished; so we had green fodder completely inclosed, first, by an air-tight box; second, surrounded by a six-inch packing of loamy soil; and third, outside, by an air-tight hardwood barrel.

In each of these three forms we used cut and uncut fresh clover, rye grasses, and permanent pasture—very succulent and none near maturity; the plants were so tender that the screw abrased and discoloured them as well as pressed out the natural sap to a considerable extent.

Mr. H. Woods, in his lecture at South Kensington, speaks more favourably of the result of his experiments:

Two years ago we put a quantity of chaffed grass and other material into casks, ramming it down compactly, and weighting it and covering it with bran, as in the silos. The result was so satisfactory that last year we extended the experiment, using casks of various sizes. The ensiled material consisted of maize, oats, brank, spurrey, and common grass. The casks were filled at different times between July and September; an operation easily, economically, and expeditiously performed. When opened in the present year the contents were found to be sound and good. There is therefore no doubt that, on well-conducted principles, with the aid of artificial pressure, crops may be ensiled in casks available for the use of cowkeepers, resident in large towns.

Brewers' grains have been stored in barrels for this purpose. Sir H. Allsopp recently stated that it was done by his father about fifty years ago.

The Rev. C. H. Ford gives the following account of a barrel experiment carried out in his part of the country:

> Mr. John Gargate, of Langdale Beck, near the High Force in this county (Durham), is a lead miner, and has a little grass land. He filled a barrel, measuring 4ft. high by 31in. in diameter, with grass from his meadow, and refilled again and again till it was full, weighting it with clean river stones. He consumed the content, which was excellent; and, spinning it out, it lasted his two cows seven weeks.
>
> Why should not every cottager who keeps a cow, like Mr. Gargate, have a row of barrels somewhere under cover filled with roadside grass, hedgeback grass, cabbage leaves, lettuce ditto, pea haulm, and even lawn mowings? I venture to say that they would find it a most useful addition to their cow's dietary, and the improved quantity and quality of their milk and butter would amply repay them for their labour.

When there is an available supply of old barrels already at hand, they may be turned to some account in small experiments of this kind; but it is very doubtful whether it will prove economical, as a rule, to silo green crops in such receptacles, wherein there must necessarily be a greater proportion of damaged fodder than in larger silos. Their cost, too, if purchased, would be high as compared with their capacity. An ordinary beer-barrel of 36 gallons contains barely six cubic feet when "full to the bung;" whereas many persons give a cow a cubic foot of silage a day, some giving two or even more. Eight or nine 36-gallon casks would be required to hold a single ton of silage of average weight, even if the barrels were perfectly full; but considering the large amount of shrinkage that ordinarily occurs in the material, when would the barrels be perfectly full? From the dimensions given of Mr. Gargate's barrel-silo, it was probably a "butt," of the capacity of 108 gallons, or three ordinary beer-barrels, and would hold about 17 cubic feet, or one-third of a ton of silage, and thus would allow the two animals about 7lb. or 8lb. a day each for the time stated.

CHAPTER IV.—COST OF SILOS.

The cost of silos must necessarily be influenced by various circumstances, such as the materials of which they are made, the dimensions that are chosen, the nature of the soil on which they are built, and the power of adapting existing buildings to new purposes. It is impossible to lay down a general rule as to what any particular structure should cost, even when the size and materials have been determined on, because local conditions will make a considerable difference in the outlay, and what may be a cheap mode of building in some districts will be very expensive in others.

In certain localities, abounding in gravel and sand, concrete may be very cheaply made, if there is a sufficient supply of water to mix the cement; in other places it may be advisable to have recourse to quarried stone; elsewhere brickwork may be more economical; while some estates may have an abundance of timber that can be profitably turned to account. Even those who would adopt the simplest form of silo, by merely digging a pit in the ground, will find that they cannot advantageously carry out in loose, porous soils, liable to incursions of water, what others can readily accomplish in firm, sound earth, out of the reach of floods.

The mere cost of excavation becomes a considerable item where pits are dug in the ground, whether these are or are not lined with masonry, concrete, or planking. Work of this kind may be said to have a fixed rate of cost in proportion to size, because, if you wish to have a pit of 10 cubic yards capacity, you must dig out 10 cubic yards of soil, and if you wish to make it two, three, or twenty times larger, you have two, three or twenty times as much work to do, and the cost is proportionately increased.

It is otherwise with structures built above ground. There, if you double the length of each of your walls, you double the cost of building them; but the space they inclose is increased fourfold, and consequently the relative cost of that space is only one-half that of the smaller enclosure. And if you make all the walls ten times as long, the space is increased 100 times, and the relative cost is only one-tenth. Obviously, therefore, large silos must be relatively much cheaper than small ones, except so far as regards the mere cost of excavation; and even where excavations form part of the scheme, if they are lined with masonry or concrete, &c., the cost of building walls in these structures will follow the same law as when the walls are wholly above ground.

Where there are unused barns, outhouses, &c., they may often be rendered serviceable as silos at a very moderate outlay, as will be seen from quotations given further on.

Estimations of Capacity and Cost.

What is here proposed to be done is, not to say that silos of such and such dimensions can be built in any way at a given cost; for, although some readers might find it true, others would find it false. Even where a manufacturer in London or any other large town undertakes to supply materials at a certain price, the conveyance by rail and road may add considerably to the first expenditure, especially if workmen are sent likewise. Widely divergent statements have, however, been made public as to what silos have cost, or must cost, but so little has been said to explain the circumstances affecting the respective buildings, differences in size, and variations in estimates of capacity, that the conflict of assertion has been very bewildering. It is thought, therefore, that a collection of facts from various sources—but for the most part English—may be serviceable to those who would form a notion of the outlay under circumstances having a certain degree of resemblance to their own; for, even though the prices may differ, there may be something to learn as regards modes of construction or utilization of different kinds of material.

In giving these statements of cost, an endeavour has been made to reduce them to a common standard. One man may say that his silo has entailed an outlay of a certain number of pounds, and that it will contain so many tons of fodder; and another may have a larger silo but be content with a much more moderate estimate of its capacity. Obviously no fair comparison can be made under such circumstances, and therefore, in all the records here given, the capacity of the silo in tons is calculated at the rate of *fifty cubic feet to the English ton*—we say English ton, because the American ton is only 2000lb., and therefore is about one-tenth less than ours, being, in fact, a little under 18cwt.

Some persons have taken 56lb. to the cubic foot (*i. e.*, 40 cubic feet to the ton) as a basis for calculating the capacity of silos; but this estimate is too high. In the first place, 56lb. is considerably above the *average* weight of silage; and although one instance is on record (p. 215) of 60lb. being reached, there are several instances (pp. 307 and 332) of only about 30lb. In the second place, when the silage has attained its maximum weight, the silo is never full.

Others have proposed to take two cubic yards as representing a ton; and this is certainly much more correct, as an average estimate, than that of half a hundredweight to the cubic foot. At first sight, too, it seems hardly possible to have a more simple formula; but when one comes to put it into practice, it proves by no means so simple as it appears, because the measurements of silos are seldom or never found to be even yards, and to reduce feet and inches into cubic yards of 27 cubic feet each is more troublesome than to calculate the tonnage by the process here adopted.

The reasons which originally induced us to take 50 cubic feet of capacity as representing a ton of silage were these:— M. Goffart has shown that his silage, well compacted under heavy pressure, had a weight of rather over 800 kilogrammes the cubic metre, which is equivalent to almost exactly 50lb. per cubic foot. He also stated that, with care in filling the silo, only about one-tenth of the space was unoccupied when the

fodder had settled down. If, then, we take 50 cubic feet at 50lb. each, we get 2500lb.; but, deducting one-tenth for unoccupied space, we have a very close approximation to the English ton, which is 2240lb.

Silos in general are seldom or never likely to contain more than a ton weight of silage in 50 cubic feet of space, whereas many that are unskilfully filled and insufficiently weighted will hold a very great deal less. How greatly some persons may be out in their estimates will therefore be seen by the following statement made by an owner of silos in reply to questions issued by the U.S. Department of Agriculture: "Last season my silo was 32ft. by 14ft., and 12ft. high; I have added 10ft. to the height, and built another the same size. The whole capacity is now 1000 tons."

This is a remarkable example of exaggerated estimate. The cubic capacity of these two silos is under 10,000ft. each, and 1000 American tons are equal to 2,000,000lb., so that, if not an inch of space were left unoccupied, the contents would have to weigh more than 100lb. per cubic foot to make up the weight stated. Our estimate of the capacity of these silos is under 200 English tons each—the total equivalent for the pair being about 440 American tons, instead of 1000.

Cost of British Silos, specially constructed.

Of the silos which have been made in the United Kingdom, full details of cost have been made known in comparatively few instances; and in those cases where information is given it is often less explicit than could be desired. We here summarise the particulars given with respect to silos which have been specially made for the purpose, whether they are elaborate and costly structures or mere pits dug in the soil; and in a subsequent page will be given those silos which have been formed by the adaptation of already-existing buildings. They are arranged in the order of cost per ton of capacity—50 cubic feet being taken, as previously explained, to represent a ton. If the cost per cubic foot should be required, a very close approximation can be obtained by

turning the shillings per ton into farthings per cubic foot; so that 20*s*. per ton would be about 20 farthings, or 5*d*. per cubic foot.

Small silos generally cost more per ton than large ones, and therefore they head the following list:

The Rev. C. H. Ford's silo (page 224) has proved a very costly one for its dimensions—15ft. by 8ft., and 9ft. deep; for, owing to the unfortunate invasion of water, and expense of well, &c., to remedy the defect, the outlay was raised considerably above the original estimate. Its capacity is 20 tons, and the cost was 50*l*. 7*s*. 3*d*., or 2*l*. 10*s*. a ton.

Mr. Firman's silo at Craig Park (page 333) is a 10ft. cube, built of concrete, and has a capacity of 20 tons. The cost was 36*l*., or 36*s*. per ton.

Mr. Wood's two silos (page 306) are each 15ft. long, 10ft. wide, and 11ft. deep, entirely below ground, and built of concrete, roofed over. Capacity, 33 tons each; cost of the pair 100*l*., or 30*s*. per ton.

Mr. Kenyon's silo (page 308) is 11¾ft. long, 10ft. wide, and 11ft. deep, excavated near the edge of a bank, and faced with bricks set in cement; the floor is made of flag-stones, laid in mortar and jointed with cement, and a drain runs below the foundation, to carry off water into an adjacent stream. At the four corners, brickwork pillars are carried up to support a light roof, so as to form a sort of Dutch barn, for storing hay, &c. Capacity of silo, 25 tons. Cost (including covering boards) 35*l*. 10*s*., or 28*s*. per ton.

Lord Ashburton's three silos (illustrated on page 57) are each 11ft. square and 12ft. deep, built of concrete, 12in. thick, except where the walls back against the earth, in which case they are reduced to 9in. The front of the silo was inclosed with ledged shutters, to keep out drifting rains. The following statement of the total cost, including pressing apparatus, is given in the "Journal of the Bath and West of England Society:"

	£	s.	d.
Cost of the building, including walls, floors 6in. thick, output doors, roof, eaves-gutters, inclosing shutters, excavation and haulage	113	14	3
The 12 standards for compression	27	0	0
The cover planks, 3in. thick, and the six transverse timbers	10	3	6
Hydraulic jack	6	0	0
Total	£156	17	9

As in other cases where silos are specially built with a view to permanence, the cost cannot fairly be compared with others in which less regard has been paid to durability. The total capacity of these three silos is 4350 cubic feet, or 87 tons; and the cost for the building alone about 26*s*. per ton; the pressing appliances amounting to about 10*s*. per ton in addition.

On the farm of Young's Paraffin Works (page 328) a silo 20ft. long, 8ft. wide, and 7ft. deep has been built partly of brick and partly of planks. The capacity is 22 tons, and the cost, exclusive of cartage, was 26*l*. 15*s*., or about 24*s*. per ton.

Mr. Johnson's lever-pressure silo (of which illustrations are given at pp. 212-213) is built of brick with slated roof. It is 18ft. long, 10ft. wide, and 28ft. high up to the eaves, but 6ft. of this height is left for working the machinery, so that the total capacity, at 50 cubic feet to the ton, would be about 80 tons. But Mr. Johnson's silage weighed very much more than usual, as it reached 60lb. per cubic foot; and at this rate, if the whole space were occupied, fully 100 tons might be put in. The total cost of the silo and apparatus was about 150*l*., of which 65*l*. was for masonry, 40*l*. for pressing apparatus, and the remainder for roof, &c.; but Mr. Johnson was his own engineer, and the cost would have been higher had a professional man been employed to superintend the work. Deducting 40*l*. for pressing apparatus, the cost, at the same rate as in other cases, would be about 22*s*. per ton.

Mr. Hunting's silo (page 301) is 40ft. long, 12ft. wide, and 10ft. deep, built of stoue, with an inside lining of bricks laid in cement, and concrete floor; the walls are 2ft. thick, and

the roof of corrugated iron. Capacity, 96 tons; cost about 100*l*., or 21*s*. per ton.

Mr. Edwards's silos (page 276) have each a mean width of about $8\frac{1}{2}$ft. and a length of about 18ft. and depth of 8ft. Capacity about 25 tons each; cost of the pair a few shillings under 50*l*., or about 1*l*. per ton.

Mr. Gibson apparently has altered his silo since 1882, when the description was written which is reprinted on page 273; for he states in the "R.A.S. Journal" that it is 17ft. deep and has a galvanised iron roof (formed with frames on hinges, which are raised by means of pulley-blocks), and that the cost, including 5 tons of cement weights, was 230*l*. As the capacity would be about 240 tons, this would amount to about 19*s*. a ton.

Mr. Swan (page 292) has two silos, each 27ft. long, 7ft. wide, and 14ft. deep, built of 14in. brickwork faced with Portland cement. Capacity 52 tons each; cost 100*l*. 10*s*. 3*d*. or about 19*s*. a ton.

Mr. R. Johnston, of Tan-y-Park, near Cardiff, made two silos by running a brick wall across a portion of a barn, and dividing the space into equal compartments by another brick wall. The cost of this operation was 20*l*. 1*s*. 8*d*. But Mr. Johnston gives in the "R.A.S. Journal" a statement of what these silos would have cost if they had been altogether newly built. The dimensions inside are given as 17ft. long, 15ft. wide, and 17ft. high, and the number of cubic feet as 3825; but apparently there is a wrong figure in the dimensions, as $17 \times 15 \times 15$ gives 3825 as the product. The cost, in 14in. brickwork, is stated as follows:

	£	*s*.	*d*.
Bricks, 23,000, at 30*s*. per 1000	34	10	0
Lime and sand	2	15	0
Two doors and frames	1	15	0
Bottom cemented	3	10	0
Roof	12	15	0
Labour and building	11	17	0
	£67	2	0

Taking, as before, 50 cubic feet to the ton, 3825 would give

the capacity as about 76 tons; and the cost about 17*s.* 6*d.* per ton for a new building, or little more than 5*s.* per ton for the conversion.

Mr. Mouflet's wooden silo (page 281), is built of double boarding, with an intervening layer of puddled clay. It is 24ft. long, 12ft. wide, and 10ft. high, and has a capacity of about 58 tons. The cost was 53*l.*, or rather over 18*s.* per ton.

Sir T. E. Colebrooke (page 318) built for his tenant, Mr. John Morton, a stone silo, 15ft. long, 12ft. broad, and 12ft. deep, or 43 tons capacity, the cost being 38*l.*, exclusive of cartages, or about 17*s.* 6*d.* per ton.

Mr. Pochin (page 316) has erected two silos, each 24ft. long, 9ft. wide, and 12ft. deep, with stone walls 2ft. thick. The outlay is estimated at about 85*l.*; and as the capacity would be rather over 50 tons each, the cost would amount to about 17*s.* per ton.

Lord Blantyre's silo (page 319) is 54ft. long, 20ft. 4in. wide, and has walls 12ft. high, with the floor sunk 3ft. below the surface. The walls are of red brick, 14in. thick, and, as will be seen from the description, it is expensively fitted up. The cost was as follows:—Digging, carting, and carriage, 32*l.* 4*s.* 6*d.*; ironwork, 62*l.* 16*s.* 2*d.*; stones, bricks, and cement, 140*l.* 12*s.* 8*d.*; slater and plumber work, 38*l.* 1*s.*—total, 273*l.* 14*s.* 9*d.* The capacity is about 330 tons, and the cost 16*s.* 6*d.* per ton.

Mr. Bateman's silo (page 274) is very similar in character to the "Kentish silo," of which an illustration is given on page 64. It is divided into three compartments each about 15ft. square, and 13ft. deep, the total length of the building outside being 47ft. and the width 17ft. The walls are of concrete faced with cement, and are 1ft. thick. The roof of two compartments was of corrugated iron (for which it is proposed to substitute Willesden paper); the third was covered by a haystack. The total cost was about 160*l.*, or 19*s.* a ton on a total capacity of about 170 tons. Mr. Bateman says that by roofing with Willesden paper, instead of corru-

gated iron, the cost would be reduced by about 20*l.*, which would lower the rate to about 16*s.* 6*d.* per ton.

Mr. Wills's silo (page 244) is 14ft. by 12ft. and 13ft. deep, the walls being of limestone, 2ft. thick, the floor of flags, and the roof of pantiles. Capacity, 43 tons; cost about 36*l.*, or 16*s.* 6*d.* per ton.

Mr. Kirby's silo (page 283) is 24ft. long, 8ft. wide, and 12ft. deep, half above and half below ground. It is built of 14in. brickwork, and roofed with galvanized iron. Capacity, 46 tons; cost 30*l.*, or 13*s.* per ton.

Mr. Hamilton's silo (p. 318) is built of brickwork, cemented, and concrete floor. It is 13ft. by 10ft., and 13ft. deep, with 34 tons capacity, and cost 22*l.*, or rather over 13*s.* per ton.

Mr. Rennie's silo (page 329) is built with 2ft. stone walls, and floored with engine ashes covered with tarred wood. It is 32ft. by 9ft., and 9ft. deep (5ft. below ground), and has 52 tons capacity. The cost was 30*l.*, or about 11*s.* 6*d.* per ton.

Sir J. F. Dillon's silo (page 339) is 40ft. long, 10ft. wide, and 10ft. deep, and cost 72*l.*, of which 14*l.* was for apparatus for lifting the weights. The capacity is 80 tons; and this, on the cost of the building alone, would be equal to about 14*s.* 6*d.* per ton. But Sir John Dillon says the size of the silo could be doubled for another 30*l.*; in which case the cost would be reduced to 11*s.* per ton.

Mr. Duncan's silo at Benmore (page 330) is built of concrete, with wooden roof, and cost 160*l.* It is in two compartments, each 20ft. square, by a like depth, 15ft. of which is below ground on a slope. The capacity is 320 tons, and the cost 10*s.* per ton.

A combination silo (page 341) has been built in Ireland, from iron rails and boards, with a front of masonry. It is 70ft. long, 15ft. wide, and 16ft. deep, divided into five compartments, and has a capacity of 336 tons. It cost less than 120*l.*, or about 7*s.* per ton.

Mr. Ramsay (page 322) has a silo 28½ft. long, 14¼ft. wide, and 15ft. deep, on sloping ground, built of double bricks,

cemented, with a slate roof. Its capacity is 120 tons; and it cost about 40*l.*, exclusive of cartage, or about 6*s.* 6*d.* per ton.

Mr. John Bourne (page 254) had a pit, 30ft. long, 15ft. wide, and 9ft. deep, excavated, and covered with a corrugated iron roof on a light wooden frame. It has 80 tons capacity; and the total cost was 15*l.*, or less than 4*s.* per ton.

Mr. Scott's silos (page 235) are three in number—one 10ft. long, 13ft. wide, and 12ft. deep, dug in the ground (soil, clay upon chalk) and cemented, at a cost of about 5*l.* The other two, which are 11ft. in length, and 8ft. in width and depth, were formed out of cattle-feeding pits at a cost of about 30*s.* each. The first-mentioned would be little more than 3*s.* a ton capacity, and the others about 2*s.* a ton.

Mr. G. Young (page 321) constructed a silo in a sloping bank, the sides and ends being of wood planking. It is 60ft. long, 10ft. wide, and 10ft. deep (5ft. underground), and has a capacity of 120 tons. The proprietor (Sir G. Houstoun Boswall, Bart.) gave the timber, and the cost to the tenant was about 15*l.*, or rather over 1*s.* 6*d.* a ton.

Mr. Solomon (page 285) puts the cost of digging his earthen silo at 30*s.*, which seems a very moderate sum, considering the size of the pit, viz., 21ft. long by 12ft. wide, and 9½ft. deep. It is not clear, however, how much of this depth was temporarily made up by boards; but supposing the excavation to have been 6ft. deep, the cost would be little more than 6*d.* a cubic yard. Mr. Solomon estimates the cost at 1*s.* 6*d.* per ton of silage.

Mr. Urquhart's silo, on Lord Seafield's estate (page 320) was dug out of a bank, at a cost of 3*l.* 8*s.*; and being 16ft. by 16ft., and 9ft. deep, its capacity would be about 46 tons, and the cost about 1*s.* 6*d.* per ton.

This cost (1*s.* 6*d.* per ton capacity) seems as low as it can well be, in this country, for earth silos. The mere expense of excavation appears to vary from 8*d.* to 1*s.* per cubic yard. Mr. Willan (page 235) got his gravel dug out for 8*d.* a yard in Hampshire; Mr. Potter states 9*d.* a yard as a fair price for excavating chalk in the same county; and the Rev. C. H.

Ford (page 224) gives 1*s.* a yard as the cost of excavating clay in the county of Durham. As a cubic yard contains 27 cubic feet, nearly two cubic yards would therefore be required for a ton, on the basis of 50 feet to the ton.

As remarked on page 90, the cost of excavation must be a constant quantity; for if you wish to obtain an underground silo of a given capacity you must dig out a corresponding quantity of earth, whereas, if you wish to make an inclosure above ground, or to build walls in an excavated pit, the relative cost decreases continually with increase of dimensions. With regard to cost in the chalk district of Hampshire, Mr. T. Potter says:

The cost of silo construction must in a measure depend upon the nature of the soil to be excavated and the price of materials and labour, but by far the most important factor in the calculation is the size of the silo. Assuming, for instance, that two silos are about to be built, the lesser 10ft. square and 10ft. deep, and the larger 20ft. square and 10ft. deep, also that the walls are to be of concrete 9in. thick, the bottom of concrete 6in. thick, costing 14*s.* per cubic yard, the walls faced internally with Portland cement at 1*s.* per superficial yard (and the excavation is in chalk soil costing 9*d.* per cubic yard, and these figures should be a close approximation for Hampshire silos in chalk soil), we should get the following result:

Cost.	Capacity in Cubic feet.	Cost per Cubic foot.	Remarks.
Large silo ... 29*l.*	4000	$1\frac{3}{4}$*d.* nearly	Exclusive of roof or compression
Small silo......14*l.*	1000	$3\frac{1}{2}$*d.* nearly	appliances.

With regard to roofs nothing could be more suitable than galvanized iron, but, instead of the ordinary "principals," or main rafters, curved ribs formed of three thicknesses of 9in. by $\frac{3}{4}$in. board nailed together are the best in every way. A waggon load of timber would construct a roof of this kind 60ft. by 30ft., and the total cost of wood, iron, and labour need not exceed 2*l.* per square of 100 superficial feet, while single spans up to 30ft. or 35ft. are as easy of construction as smaller ones.

Converted Buildings.

The difference in the amount of alterations and additions in converted buildings varies considerably, and there is a corresponding variation in the cost. In some cases only a wall or two have been utilised; and when substantial roofs,

concrete floors, and other additions have been made, the outlay has been as great as with entirely new structures of a less lasting character, as will be seen by the following particulars:

Earl Fortescue's silo (page 240) is 19ft. long, $6\frac{3}{4}$ft. wide, and $5\frac{1}{4}$ft. deep. Three existing stone walls were utilised, and the fourth built; and it is roofed with corrugated iron. The cost was 11*l*. 10*s*., of which about 4*l*. 10*s*. was for labour. Capacity about 13 tons, and cost 18*s*. per ton.

Mr. Harris's (page 238), 35ft. long, 18ft. wide, and $10\frac{1}{2}$ft. deep, was formed out of a disused manure shed; but the work has been done very substantially, with a good slate roof, and altogether cost 110*l*., which, with a capacity of 130 tons, would amount to nearly 17*s*. per ton.

On the Marquis of Bute's home farm (p. 324) a silo 18ft. long, 6ft. wide, and 8ft. deep was formed in part of a barn, by running a brick partition across, and cementing the floor and walls. The cost was 10*l*. 16*s*., and the capacity 17 tons, or about 12*s*. 6*d*. per ton.

Mr. Kemp's silo, on Lord Seafield's estate (page 320) was formed out of a disused building, and divided into two compartments by a concrete wall. They measure 16ft. by $13\frac{1}{2}$ft. each, and 15ft. high. The cost was 80*l*., and the capacity is about 130 tons, or rather more than 12*s*. per ton.

Lord Walsingham's three silos (page 261), made in a clay-built barn, and having about 50 tons capacity, cost 30*l*., or 12*s*. per ton.

Mr. Lowe's silo (page 253) is 27ft. long, 17ft. wide, and 10ft. deep, the rubble stone walls of an old barn having been utilised, made level, and cemented, at a cost of about 50*l*. The capacity is 92 tons, or 11*s*. per ton.

Mr. Bourne's, at Hilderstone Hall (page 254), was excavated under the roof of a Dutch barn, and is walled and double-bottomed with bricks. It is 31ft. long, 12ft. wide, and 12ft. deep. The cost (including planks for covering) was 48*l*. 13*s*., and the capacity is nearly 90 tons, or about 11*s*. per ton.

The Duke of Hamilton's silos (page 271) were constructed in the bay of a barn, the walls being of 14in. brickwork coated with cement, and the floors of concrete cemented. They are each 22ft. long, 8ft. wide, and 10ft. deep, giving a capacity of 35 tons each; and the cost of the pair was about 36*l*., or a trifle more than 10*s*. per ton capacity.

Lord Londesborough's silo (page 306) is 13ft. long, 8ft. wide, and 10½ft. deep, made in the end of a barn, at a cost of 12*l*. Its capacity being 22 tons, this amounts to about 11*s*. per ton.

At the Croydon Sewage Farm (page 281), a concrete silo 15ft. by 8ft., and 10ft. deep (3ft. underground), was erected against the brick wall of a shed, at a cost of about 12*l*. The capacity being 24 tons, the cost amounted to 10*s*. per ton.

Mr. Willan's silo (page 235) was excavated in the bay of a barn, and then bricked and cemented. Its capacity is 1850 cubic feet, or 37 tons, and the cost 18*l*. 10*s*. 6*d*., or about 10*s*. a ton.

Mr. A. Grant says (page 231): "I am now making a silo in a barn. I shall not therefore have to charge for the cost of a roof, as the barn, when the silo is filled, will be just as useful for storage of corn, &c., as before. The gravel which I have dug out (about 5*l*. worth) just balances the cost of digging. The silo will be about 21ft. long, by 16ft. wide, by 10ft. deep —of which depth 7ft. will be excavated, 3ft. filled up to the level of the old barn floor. Bricks and bricklayer's labour, cement, and lime, will cost about 15*l*., and weights perhaps 8*l*. more; rough fir slabs 2*l*. I thus get a large silo complete for 25*l*.; but this cheap construction can only be obtained nnder very favourable circumstances." The capacity of this silo would be 68 tons, and the cost under 7*s*. 6*d*. a ton.

Messrs. Broderick's silos (pp. 216 and 218) were converted out of existing stone hay-barns, which have been cemented and floored with concrete. The first pair are each 14ft. square by 18ft. deep, and cost about 50*l*. to convert, or 7*s*. per ton on a capacity of 70 tons each. Another, which is 22½ft. long, 10ft. wide, and 19ft. deep, cost about 20*l*. to convert, or less than 5*s*. per ton on 85 tons capacity. And

another, which is 13ft. square by 15ft. deep, cost about 10*l.*, or 4*s.* a ton on 50 tons capacity.

Cost of Silos of Portable Concrete Slabs.

Particulars are given at page 73 with respect to the mode of constructing Lascelles' silos made of portable concrete slabs. These slabs, which are 3ft. by 2ft., cost 2*s.* each, or 4*d.* per square foot; and the $4\frac{1}{2}$in. × 3in. quartering, used for fixing them together, costs 4*d.* per foot run, if morticed and tenoned, or a trifle less if not. The quantities and cost of materials for the silo described at page 74 (15ft. long, 12ft. wide, and 10ft. high) are thus stated by Mr. Lascelles:

	£	*s.*	*d.*
220 feet of post at 4*d.*	3	13	4
108 feet of plate at 4*d.*	1	16	0
90 slabs, each 36in. by 24in.	9	0	0
Screws for ditto	0	3	0
12 iron squares for corners, bolts, cross ties, and tarred cord for joints	1	15	0
	£16	7	4

The cubic contents being 1800ft., the capacity would, at the rate previously stated (50 cubic feet to the ton), be 36 tons, and the cost about 9*s.* a ton. The larger the structure, the less would be the comparative cost for materials; and a silo 60ft. by 24ft. and 12ft. high would contain about ten times as much as the above (viz., 355 tons), while the cost would be little more than 3*s.* a ton. The above is the price in London; to this would have to be added the expense of carriage and of fixing, and of roof also, if required. The cost of fixing the above-mentioned silo is stated, at page 289, to be 2*l.*; a similar silo is mentioned at p. 288, as erected inside a barn, so it would require no roof; and a larger one, with corrugated iron roof, described at p. 272, cost, including carriage, a trifle under 50*l.* This is 24ft. by 18ft., and 12ft. high, giving a capacity of about 104 tons.

Mr. Arthur M. Cardwell (p. 288) gave in the *Field* the

following estimate, based on his own experience, of the total cost of a concrete slab silo, 24ft. long, 12ft. wide, and 12ft. deep, including roof, bricks for weighting, &c.: Silo, 25*l.*; fixing, 1*l.*; concrete floor, 2*l.*; carriage, 2*l.*; bricks for weighting, 10*l.*; roof, 10*l.*—total cost, 50*l.*

It need hardly be stated that estimates of cost of different sizes of these, as well as other kinds of silos hereafter mentioned, may be obtained on application to the respective makers.

Patent Wooden Silos.

The wooden silos made by Messrs. Churchton and Co., described at page 80, are made of 11in. × 3in. and 9in. × 3in. timber in the principal parts, the sides, tops, and bottoms being of plank 1½in. to 2½in. thick. They are supplied complete, with bottom and top planks and all necessary bolts and screws, at the undermentioned prices for the sizes named, but larger ones may be had on application. In the following table we have calculated the estimated capacity of the silos according to the rule previously laid down (50 cubic feet to the ton) and have substituted these figures for Messrs. Churchton's, which are about 10 per cent. higher. We have also added the relative cost per ton on this basis.

	Capacity.	Cost.
12ft. long, 8ft. wide, and 10ft. deep ...	19 tons ...	16*l.*, or 17*s.* per ton.
16ft. „ 10ft. „ „ 10ft. „ ...	32 „ ...	20*l.*, or 12*s.* 6*d.* „
20ft. „ 10ft. „ „ 10ft. „ ...	40 „ ...	26*l.*, or 13*s.* „
24ft. „ 12ft. „ „ 10ft. „ ...	58 „ ...	32*l.*, or 11*s.* „
28ft. „ 14ft. „ „ 10ft. „ ...	78 „ ...	36*l.*, or 9*s.* „

This does not include the roof, the price of which would vary with the material. Messrs. Churchton also supply plans for the construction of silos on their principle on payment of a royalty.

The dimensions and prices of the circular wooden silos made by Messrs. Reynolds and Co., as depicted on page 81, are as stated on the next page; but, as in the previous instance, we have substituted our own calculations as to their capacity, and added the corresponding cost per ton.

	Capacity.	Cost.
10ft. 11in. diameter by 9ft. high ...	15 tons ...	9*l.*, or 12*s.* per ton.
12ft. 4in. „ by 11ft. „ ...	26 „ ...	14*l.*, or 11*s.* „
15ft. „ by 12ft. „ ...	42 „ ...	20*l.*, or 9*s.* 6*d.* „

The waterproof canvas roof would cost from 2*l.* 10*s.* to 5*l.*, according to size, and the covering-boards would be extra.

Mr. Stocks' silo with screw pressure is figured and described at page 78. A wooden silo, 20ft. by 10ft., and 10ft. deep, would cost 50*l.*; and as the capacity is 40 tons, this amounts to 25*s.* per ton, including the pressing apparatus. The press and springs can be applied to any silo of the same size at a cost of 18*l.*

COST OF FRENCH SILOS.

In France it may be expected that silos would cost less than in England, because labour is cheaper; and the statements made by M. Goffart and the Vicomte de Chezelles both bear out this impression. In excavation alone a large saving would be effected. The particulars of cost of M. de Chezelles' silo, at page 199, give 65 centimes per cubic metre (or barely 5*d.* per cubic yard) as the charge for excavating and carting earth. This compares very favourably with the lowest of the English charges for excavation only, as given on page 190. In one of the American returns quoted in the official report the sum stated for excavating and carting is equivalent to about 2*s.* 3*d.* per cubic yard; verily a most remarkable difference. In concrete work there is not such a wide divergence—Mr. Bailey stating it as 10 cents per cubic foot (or about 11*s.* per cubic yard) in America, while M. Goffart gives it at 12 francs the metre (or 7*s.* 6*d.* per yard) in the account opposite. The brickwork, at 20f. per cubic metre, is equal to about 12*s.* 6*d.* per cubic yard. In England, in very favourable localities, concrete may cost 6*s.* or 7*s.* per cubic yard, and in others it will cost as much as brick or stone, if not more. Mr. Potter, in the estimate on page 101, puts it at 14*s.* per cubic yard in Hampshire.

M. Goffart gives the following particulars respecting the construction of his last silos, which, he says, were much more

costly than they would be in many places, owing to the nature of the soil:

My farm at Burtin presents exceptional difficulties to the formation of silos. It is traversed by a little river, the Néant, which has a weir across it for the service of my water-wheel, and thus a very high head of water is kept throughout the neighbourhood. Everywhere on the farm, water is found at the depth of about 3ft.; and, as I always make my silos at least 6ft. deep (because the underground part keeps much cooler in summer than that which is above the soil), I am obliged to make this lower portion water-tight, in order to avoid flooding; and this entails a pretty heavy outlay. The works are as follows:

The excavation made for the foundation of my silos is carried down about 7ft. below the ground level. In order to dig so far down without being stopped by water, it is necessary in the first place, to cut a drain to carry off the waters to the depth of 7ft., and conduct them into the mill stream about 80 yards below the turbine.

The excavation being finished without obstruction, owing to this preliminary drainage, I lay down, over its whole extent, a bed of concrete, 6in. thick, composed of broken bricks and hydraulic cement. Upon this bed of concrete I build, up to the ground level, vertical walls, which form the boundaries of my silos, making them two bricks (or 18in.) thick. Above ground, I reduce the thickness of the walls to a brick and a half (about 14in), and then carry them up to their full height of about 17ft. Finally, I give the inside and the bottom a coating of Portland cement, so as to make the whole perfectly water-tight. These works cost:

155·562 cubic metres of ordinary brickwork, at the rate of 20 francs the cubic metre	3111f.	24c.
30·47 cubic metres of concrete, at 12 francs the metre ...	365	64
Cost of excavation, coating with cement, and other expenses, about	700	0
Total	4761f.	88c.

My three connected silos thus will have cost me as nearly as may be 4176f. 88c. (about 167*l.*); and as their total capacity is 812·45 cubic metres, each cubic metre of capacity will have cost me 5f. 14c.

These explanations suffice to show that silos at Burtin cost more than in most cases. I had to build on perfectly flat ground, often full of water, the intrusion of which into the silo must be prevented at any cost. I had sad experience of this not long ago. The water found its way through a crevice into one of my silos filled with green rye, and all that part which the water reached, to the depth of about a foot, was spoilt. I have therefore spared no expense to attain the desired end, and I am certain of having attained it, by drainage especially.

A cubic metre being equal to about 35⅓ cubic feet, the

total capacity of these silos will be about 28,690 cubic feet, or 570 tons, and the cost barely 1½*d*. per cubic foot, or about 6*s*. per ton; but to this would have to be added the roofing, of which no mention is made.

The cost of the Vicomte de Chezelles' large silo is proportionately much less without its covering—which, however, is not merely a roof, but is a kind of Dutch barn, in which are stored the grain crops of the farm. From the particulars given at page 199, it will be seen that the cost of the silo alone was about 160*l*., and that of the barn superstructure 250*l*., or 410*l*. in all. The capacity, estimated as before stated, would be about 1200 tons, or about 2*s*. 6*d*. per ton for silo alone, and nearly 7*s*. a ton if the Dutch barn be considered merely as the roof of the silo—which, however, would not be a fair representation of the facts, seeing that the barn is applied to other purposes.

Relative Capacity and Cost of Silos and Hay-Barns.

Many landowners build on their estates permanent hay-barns for the use of their tenants; and as, by the pitting of green crops instead of drying them, it may become desirable to construct one kind of permanent building instead of another, it may be as well, while considering the capacity and cost of silos, to take into consideration also the cost and capacity of hay-barns. No doubt it may be said that hay-barns can be dispensed with, as, indeed, is already done on many farms, where the hay is stacked and thatched, instead of being put under roofs; but, although this is so commonly done, it does not follow that it is the best course of procedure; and, unless hay-barns were believed to be economical in the end, it is hardly to be supposed that the owners would go to the expense of building them at all.

With the keeping of hay, as with the preservation of pitted fodder, there are two modes of proceeding. You may have sound permanent buildings that will last for generations, or you may have makeshift contrivances which avoid any large outlay at first, but entail a continued repetition of indirect

expenditure afterwards. Silos of masonry, &c., may be dispensed with, in like manner as it is possible to dispense with hay-barns; the fodder may simply be buried in the earth, as already shown, instead of being put in permanent buildings; but persons who have had long experience with the rough methods have nevertheless found it worth their while to go to the expense of replacing them by masonry and concrete, as being, on the whole, more economical. Beginners can choose for themselves which course they prefer.

The pitted fodder is so much heavier than hay, owing to its being preserved with all its moisture, and thus being about three-fourths water, that some persons seem to imagine it must occupy a large amount of space as compared with hay. But the reverse of this is the case; for if a barn were turned into a silo, it would contain about double as many acres of grass as it would hold if the grass were made into hay.

Dry hay, as it is commonly called, contains, on the average, about 15 per cent. of moisture, so that in a ton of hay there would be about 17cwt. of really dry substance. The silage made from grass contains, on the average, about 70 per cent. of moisture; and in a ton there would consequently be 6cwt. of dry substance, or little more than one-third of that contained in a ton of hay.

Hay, however, would require about six times as much storage room as silage. When first packed in a barn it could hardly exceed 7lb. or 8lb. per cubic foot, so that about 300 cubic feet would be requisite to hold a ton. Hence, weight for weight, silage would contain one-third the feeding-matter and occupy one-sixth the space of hay; consequently, for an equal quantity of feeding-matter, silage would require only half the space of hay.

This, however, can only be approximate, and apply to average circumstances. The quantity of moisture in grass, both before and after it has been siloed, varies considerably, and the actual weight of silage as compared with hay must necessarily depend upon the proportion of that moisture

which has been evaporated in the one case and retained in the other. Supposing that equal portions of a field of grass were cut in the same condition, one acre being converted into hay and another put into the silo, and that, on the one hand, there were no loss in the hay-making process beyond mere reduction in weight by evaporation of water, while, on the other hand, no loss were sustained by fermentation in the silo, then the proportion of silage to hay would vary simply in accordance with the moisture in the grass. Hay contains, on the average, about 15 per cent. of water; and, taking this as the standard for comparison, the relative proportions of silage and hay, according to the amount of moisture in the grass, would be as follows:

Amount of Moisture in Grass.	Proportionate weight per acre of Silage and Hay.
83 per cent.	Silage about 5 times the weight of the hay.
81 " "	" " 4½ " " " "
78 " "	" " 4 " " " "
75 " "	" " 3½ " " " "
71 " "	" " 3 " " " "
65 " "	" " 2½ " " " "
56 " "	" " 2 " " " "
50 " "	" " 1¾ " " " "

The highest percentage of moisture in grass silage of which we have seen any analysis is rather over 81 per cent., and the lowest about 51 per cent.

As to the cost of permanent hay-barns, there will be found in the *Field* of March 3, 1883, a plan and statement of cost of some hay-barns built upon the Earl of Shrewsbury's estates in Shropshire, Staffordshire, &c. Although sound and well-built, they are not extravagant structures, but are recommended on account of their economy. The cost is from 12*l.* to 14*l.* per bay, according as a large or a small number is built, and the capacity of the bay is about 14 or 15 tons, so that the cost would be about 18*s.* per ton; and, as a ton of hay averages about three times as much dry feeding-matter as a ton of silage, 18*s.* per ton for the hay-barn would be about equivalent to 6*s.* per ton for the silo.

Roofs over Silos.

A considerable difference in the outlay will be necessary if roofs are dispensed with. Such is not unfrequently done in France, where the silos are covered by means of faggots, trusses of straw, or any other convenient matters, being stacked over the pit, thus affording shelter as well as weight. In some cases a thicker layer of soil is made to answer the same purpose—a rick cloth being first placed over the fodder, in some instances, if the earth is porous. Both these methods have been adopted by M. Goffart, and the latter is used by some Americans farmers. Still, there is no doubt that roofs are advantageous; and M. Goffart said on this point:

I have of late come to the conclusion that large silos should not be without a permanent roof. The absence of covering was not inconvenient for my small silos, which could be quickly covered up by means of a few hundred faggots, but it was no longer the same when my silos had each of them more than 500ft. of surface. I have therefore decided to cover each of my new silos by a slate roof, although it is somewhat costly. The most economical roof would doubtless be obtained by the use of bituminous paper, for which a light framework would suffice. Unfortunately it only answers when it is of excellent quality and put up by able workmen.

For such a purpose the "Willesden Paper," made by the Waterproof Paper Company, Canal Works, Willesden Junction, is apparently well adapted. It is 4½ft. wide, made in long lengths, and varies in price according to thickness; the 4-ply or roofing paper costing about 2*d.* per square foot. Mr. Grant (page 227) points out, however, that this paper will not stand rough treatment, and that men are apt to make holes in the roof with their forks when filling; he therefore prefers corrugated iron. Roofs of this material are shown at pp. 57 and 72; and at p. 65 is a sliding roof running on rollers. Boarded roofs, thatch, and other materials are also used, as convenience and economy determine.

CHAPTER V.—FILLING THE SILO.

As soon as the crop is cut, it should be put into the pit, and not be allowed to lie and wither in the sun. When water evaporates from the plant, air enters and occupies the vacant cells; and air in the silo is much more to be feared than damp. Indeed, with the ordinary green crops grown in this country, there seems to be little fear of their containing too much moisture for ensilage. Even maize, which has a larger proportion of water than our grasses and clovers, is not found too moist when pitted alone.

Mixture of Dry Material with Green Fodder.

It has been stated that, in order to absorb the moisture in the green fodder, it is necessary to mix with it some amount of dry chaff. This, however, is a mistake, and is contradicted by the experience of years in France and America, as well as by results already obtained in England. The addition of dry chaff may even do more harm than good, especially if added in large proportions. The effects of mixing dry chaff with green fodder are thus stated by M. Goffart:

> When I first began with ensilage, I had, as the chief means of feeding my beasts, a very large quantity of straw chaff, and whole straw of wheat, rye, oats, &c. To induce the beasts to eat it, I mixed it as much as possible with maize and rye chopped up green; but I was not long in finding out that the greater the proportion of straw the less the time the mixture would keep. One fifth in volume, or one tenth part by weight, was the utmost the maize would take without being quickly impaired. When I exceeded these limits, the time it would keep diminished continually, and ended by not lasting longer than forty-eight hours. I attribute this to the fact that the straw, which is very dry by itself, takes from the maize too large a proportion of its moisture.

A moist condition, instead of being a cause of deterioration in ensilage, is, on the contrary, in some measure indispensable to the good preservation of the materials put into the silo.

In its normal condition, maize contains 85 per cent of water. When, by the addition of dry straw, the average amount of water in the mixture is reduced below 75 per cent., its good preservation is greatly compromised, and becomes impossible if an attempt is made to go much beyond that.

Rye and wheat chaff is often mixed by M. Goffart with his chopped green fodder, before putting it into the pit, not for the purpose of securing better conservation in the damp herbage, but in order to render digestible that which is dry. With oat-straw, and other soft material, it sufficed to mix the chaff with the silage after the latter is taken out of the pit.

Influence of Wet Weather.

From many quarters at home and abroad, there is evidence that fodder can be pitted in wet weather, and yet do well. M. Goffart thus answers a question on this subject:

Is there any inconvenience in putting maize into the silo when wet with rain?—None at all. Last October I filled my silo in the open air in frightful weather. On several occasions the rain fell in torrents; but the success of that ensilage was none the less complete.

M. Lecouteux, in an article quoted at page 20, relative to the ensilage of Trifolium incarnatum, mentions that he had put cartloads into the silo when dripping wet; and the Vicomte de Chezelles did the same with his mixed clovers, the conservation being excellent in both cases. American writers have also given information to much the same effect; and now we have evidence of a similar character from many English experimenters.

Mr. G. Broderick says (p. 219): "We have pitted grass in dry weather when it was free from external moisture, and also when it was dripping wet, with no material difference in the preservation resulting, except that when it is put in wet there is more soakage at the bottom—which should not be wasted—and less heating during fermentation. With ordinary grass I think it is better to err on the wet side, if either. If it is

allowed to dry in the sun for a few hours, the heating in the silo will be much greater."

In Sir Richard Glyn's silo (p. 237) "the grass was put in very wet, but the sample of ensilage was good both in colour and smell."

In Mr. Harris's silo (p. 239), "some of the first crops had been carried in a wet state, and with no bad result."

Lord Tollemache had filled one of his silos with wet grass, cut after a night's rain in June, and the contents of the pit, when opened in April, were found to be in sweet and sound condition. His lordship said (p. 249) that "he should now have no hesitancy in filling these silos in any weather; if at all, he would undoubtedly give preference to grass containing moisture."

Mr. Trepplin says (p. 259) that some grass cut in September "being carried damp, settled down quickly, and, after being covered with some old hay or a few boards, turned out as good as the ensilage made in the summer and weighted heavily."

Mr. Miller (p. 293) siloed meadow grass, and rye grass and clover, when quite wet, and this came out in good condition.

Mr. Wilson says (p. 297) "Mine was cut and put into the silo on as wet a day as ever rained on the face of the earth. It was a perfect wet squash when put in." Grass and oats were put in alternately, and both kept remarkably well.

Mr. Stobart says (p. 298) that "they did not take wet days in preference to dry days in filling the pit, but the pit had been filled regardless of the weather, and it rained during the whole of the three days the men were at work." The results were very good, as detailed by Mr. Easdale at p. 207.

Mr. Kenyon writes (p. 311): "At the same time that the silo was being filled with coarse herbage from a poor sideland field, we were endeavouring to save a crop of hay from an upland meadow, very favourably situated for drying in ordinary seasons. When the sun shone out for a brief season, all hands repaired to the hayfield; when clouds and rain prevailed, they resorted to making ensilage. In the one case, in fact, we 'improved each shining hour;' in the other we utilised

each wet and cloudy one. Yet, strange to say, the measure of success was in precisely inverse ratio to the care and expense bestowed. The hay—badly weathered in spite of all our efforts—was only used, because only fit, for bedding the cattle, which were actually fed upon the ensilage already described, ensilage composed of the coarsest kind of herbage, and carried cut into chaff, and pitted regardless of the rain. And, what is perhaps quite as remarkable, the animals grew and throve remarkably well during the three months they were fed upon this rough kind of ensilage."

In describing the experiments in Mr. Oakeley's silos, Mr. Dunlop says (pp. 373-4) "The second time this silo was filled (in July) it was raining hard; the grass was quite wet, and was put into the silo during weather in which nothing could be done at haymaking. . . . To-day (March 1st) the ensilage was cut from top to bottom, the result being that the quality of the same throughout was highly satisfactory. Within a few inches from the heather (on the top) the ensilage gave forth a most pleasant aroma, perhaps a little strong, but when it was cut down two or three feet it became perfectly sweet."

A number of other letters might be quoted, showing that crops have been pitted in various degrees of dampness from dew and rain, and with more or less satisfactory results; but sufficient has been said to make it evident that wet is not so injurious as some persons have imagined, and that, where the conservation of the fodder has been defective, it may have been due to a cause irrespective of the quantity of moisture in the crop.

Chopping up Fodder.

Our ordinary British fodder crops do not, as a rule, require to be chopped up in the same way as maize. An exception may be made with respect to rye, which is so hard in the straw; but with our grasses and clovers the operation may be dispensed with; and, indeed, it will be difficult to improve upon the sample of unchopped grass siloed by Mr. A. Grant, who has given details of his operations (with an analysis of

the product) in an article which appears at page 226. Clovers will doubtless require greater pressure than meadow grass, especially if left till the stems have become hard; but they should not be so left, it being best, as a rule, to cut fodder for ensilage while it is young and full of sap. Of course, if any-one has convenience for cutting up the fodder into chaff, this may be carried out, as in the case of the Vicomte de Chezelles (page 195), who passed through a powerful chaff-cutter the produce of 170 acres of clover, sainfoin, lucerne, tares, and artificial grasses, before putting the fodder in his silo.

Maize, like mangold, is a fodder which is more profitably consumed when chopped up than when given whole; and as a matter of economy M. Goffart strongly advocates the chopping. For meadow grass and other soft-stemmed crops, however, he does not consider it necessary to go to the same trouble as for maize, rye, buckwheat, &c. He says: "Chopped fodders always pack more regularly and consequently keep better. Nevertheless, for the smaller plants and aftermaths this operation is unnecessary: it would be time and trouble utterly thrown away."

M. Lecouteux also says: "In our opinion, it is useless to chop fodders with short soft stems, such as clovers, vetches, second cuts of lucerne, and meadow grass."

Many of our English experimenters, however, think that it is best to chaff grass, &c.; but some who have tried both methods have come to a different conclusion.

Mr Kenyon says (p. 312): "Hitherto I had always cut the grass into chaff before packing it into the silo; but last year (1883) I pitted it long, just as it came from the field. This plan, than which nothing could be more simple, has answered perfectly. The ensilage, although mostly put in wet, like the previous years, is, to say the least, quite as good as any that has gone before it. . . . . For my own part, although I have water power and chaff-cutters, I don't intend to chop up my grass in future; for, besides the saving of expense, there is less waste in handling the unchaffed ensilage. In this

condition, too, it can be supplied to stock in either racks or troughs, whichever may be most convenient."

Mr. M'Connel, who siloed both chopped and unchopped fodder last year, says (p. 323) that "he does not intend to chaff this year before siloing: it is both troublesome and expensive."

Mr. Grant says: "Chaff-cutting is certainly unnecessary, and therefore a useless expense, with all the grasses, &c., which I have mentioned above"—(p. 228).

Mr. Broderick says (p. 217): "It is quite unnecessary to chop grass for ensilage: a little more pressure will do just as well."

Mr. Biddell reports (p. 272) that the chaffed and unchaffed sainfoin in the silo of the Hon. St. Vincent Saumarez were equally well preserved.

Mr. Bateman (p. 275) pitted both chopped and unchopped fodders with good results.

We have seen both kinds in such excellent condition that it would be difficult to surpass them in quality; but unchopped fodders do not succeed so well when the stems are strong and stubborn, as when barley, oats, and clovers are allowed to get old and woody.

Slow *v.* Quick Filling.

Various persons have advised, with respect to the filling of silos, that it should be carried on as rapidly as possible, and that, if the process cannot be completed in one day, the boards and weights should be put on at once and not taken off again till the filling is resumed. Such, indeed, was the advice formerly given by M. Goffart; but he afterwards found cause for altering his course of procedure, as he says:

I was wrong when I formerly said: "Fill your silos as quickly as possible." Now that more effective means can be made use of, and that some agriculturists put into the silo 100 or 120 tons a day, I say, on the contrary, "Do not fill the same silo too rapidly; but so arrange as to fill several silos at a time, in order to allow a settlement to take place."

In filling a silo by putting in every day a fresh layer of maize about half a yard in thickness, you will check fermentation sufficiently mean-

while, and at the end of a week or ten days of filling in this way the spontaneous settlement will be so great that the sinking afterwards will not exceed one-tenth of the total height.

Such was the result which I obtained at Burtin last autumn. My silos, which are about 16½ft. in height, had an empty space at top of about 20in., or only one-tenth of their capacity.

This advice is supported by the experiences of various other authorities, both in France and America. M. Lecouteux says, in his book on ensilage:

It is not necessary to fill a silo to its full height at once. A night suffices to produce a sufficient settlement to admit of a very advantageous refilling, not only because of the new mass added to the heap, but still more by reason of the check it gives to a too active fermentation in the layers underneath. This is beyond doubt. Any forage that is freshly cut and put upon a mass that is heated, serves to cool that mass, and from this cooling a general fermentation results which is best adapted to the whole.

Writing to the *Journal d'Agriculture Pratique,* M. Nivière gave the following particulars of an experiment of his:

I commenced on May 28 and finished at mid-day on June 5; the filling therefore extended over eight days and a half. In prolonging this operation I proposed to obtain a more complete utilisation of the silo, which is 46ft. long, 13ft. wide, and 13ft. deep. Last year the filling was carried on rapidly until the forage was about a foot above the walls; but it sank so much afterwards that the mass was eventually only about 4½ft. in height, 80 loads of Trifolium incarnatum having been put in.

This year I have more than doubled that quantity, having been able to store 195 loads of meadow grass, mixed clover and rye grass, and Trifolium incarnatum sown with oats. I arrived at this result by leaving rather long intervals during the filling, two being of 18 hours and one of 36 hours complete stoppage. I constantly followed, by means of a thermometer, the changes of temperature, which varied from 15° C. (59° F.) on the forage arriving at the silo, to 26° C. (79° F.) and 32° C. (90° F.) at the moment of resuming operations after stoppages of 18 and 36 hours. An addition of fresh forage checked this fermentation, which after the ordinary night's stoppage always showed a temperature of about 26° C. (79° F.) at 20in. below the surface, gradually diminishing to 21° (70° F.) towards the bottom, and to 15° C. (59° F.) at the top.

It seems to me clear that the filling may be prolonged much beyond the limit usually laid down; that you may, for instance, go on filling up till mid-day, and then stop work till next morning; by this means double

the quantity of stuff can be put into the silo, and the percentage on the cost of construction is lessened accordingly. . . . .

There is no appreciable difference in the colour and flavour of the different layers; there is less damage than in the previous year along the walls in the upper portion, and no damage whatever in the lower two-thirds. A cubic metre weighs 920 kilos in the lower half and 880 in the upper (about 58lb. and 55lb. per cubic foot respectively). The height of the compressed mass is about 8ft. I found at 18in. above ground a wooden lath that I had placed across the silo on the top of the forage at the time when it was 8ft. above ground; this reduction of about four-fifths is explained by the immense weight of the 6½ft. of silage which pressed upon that below, and which, together with the weight on the surface, gave a pressure of about 400lb. per square foot. The greatest possible height in the construction of a silo is therefore a certain condition of success and of economy.

As to diminution in weight, a sample of green and very tender meadow grass which I inclosed with osier twigs, tied together by galvanised iron wire, and had placed in the centre of the mass, had been reduced from 100 kilos to 63 kilos (*i. e.*, from 220lb. to 139lb.); thus showing a loss of 37 kilos, due more, I think, to loss of water by compression than to evaporation by fermentation.

M. Lecouteux recently said, in the *Journal d'Agriculture Pratique*, with respect to the filling of long silos:

With a silo 60ft. long and 12ft. wide it is advantageous not to divide it into compartments by transverse walls. The greater the number of walls the greater the liability to damage (mouldiness), which arises in such parts of the mass as touch the walls. But it is evident that silos of great length can only be quickly filled in two ways—either by putting in the forage without loss of time (which is not always possible, owing to an insufficiency of men or teams, or by reason of bad weather coming on during the work), or else by dividing the silo into several piles formed one after the other, without intervening walls. . .

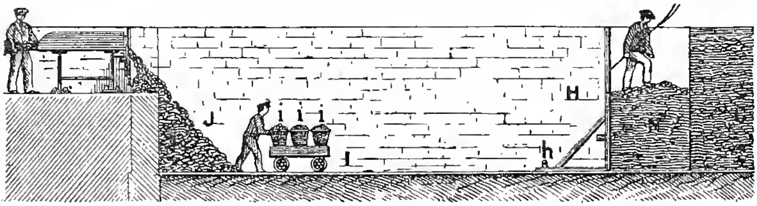
Hurry in the work is by no means necessary; and it is well not to close the silo until a certain settlement has taken place. By dividing the operation into sections, the maximum of settlement is obtained, by heaping up the mass to its full height. In other words, the same quantity of fodder spread over a length of 60ft. and to the height of 3ft. would not be much compressed by the upper layers; whereas, if spread over a length of but 15ft. there would be greatly increased height, and better compression by the upper layers. It is useless, however, to close the silo immediately: it should be allowed to settle of itself, and be filled up again after a lapse of two days, then closed and weighted.

My two silos at Cerçay are each about 45ft. long by 18ft. wide. They are only closed and weighted when the fresh fodder has reached a height

of 13ft. Eight days are required to fill the two; but there are several intervals to facilitate the settlement, which, I repeat, increases the quantity stored.

This mode of filling (which was first adopted by M. Houëtte, of La Mothe-Jarry) is better suited to chaffed material than to unchopped fodder, as the latter does not make a good junction between successive piles. From the following illustration it will be seen that a movable partition of planks is fixed across the silo, and is kept in place by stanchions, held by iron bolts driven into the floor, while movable struts (*h*) support the temporary wall. The *modus operandi* is thus described in the book of M. Lecouteux :

As soon as the maize is cut, it is carted to the chaff-cutter placed at the door of the silo. The chopped maize falls into the silo and forms the heap J; two men with large shovels fill the baskets *i*, which they place upon the truck I; this runs upon two iron rails screwed down to wooden sleepers, laid lengthwise, and held together by cross-pieces of wood.



When the truck is loaded, it is pushed by a boy up to the partition H, the baskets are handed to the builders of the pile N, who spread the stuff in thin layers and tread it as solidly as possible; on each layer is scattered a sprinkling of salt, not for the purpose of conservation, but simply as a condiment for the animals.

When the pile has reached the height of the walls, or a little above, the partition H is drawn back about six feet or so, and a new pile is begun. On the pile being completed, it is covered with a layer of clay about a foot thick, which is well beaten down; and this beating is repeated from time to time as the mass sinks.

By the process carried on at La Mothe-Jarry, the filling of a silo may extend over a fortnight, or a month if desired. You are almost independent of conditions of weather; for, provided that the cutting and carting of the crop can be proceeded with, the filling may be carried on without any inconvenience.

Since the above was written the necessity for the portable

railway and baskets has been in great measure done away with by the invention of chaff-cutters made by M. Albaret, of 63, Boulevard de Strasbourg, Paris, which propel the chopped forage a long distance into the silo. English machines for effecting a similar purpose, but differing in mode of operation, are made by Messrs. Bust, of Winterton, Lincolnshire, and Messrs. Benthall, of Maldon, Essex.

Among the most noticeable instances recorded of extension of the filling process over long periods is one narrated in the American *Cultivator* by Mr. Gilbert Morton, who says that he took twenty-one days in filling his silo, containing 70 tons; and he adds that "This shows that if we can take care to keep the corners and sides well trodden, we can take our own time in filling." There are, however, many other cases mentioned of much longer time being taken than some persons in this country think permissible. The following are a few quotations from the reports made to the U.S. Department of Agriculture :

Mr. Otis Bisbee, Poughkeepsie, New York.—"It is expedient, when nearly full, to alternate, so as to give time to settle. A covering of six inches will control the surface heat. When packing, we tread it all we can, but depend more on the natural settling."

Mr. J. B. Brown, New York.—"Not important to be in a hurry when filling silo, except to save cost; if trampled every morning it will not heat sufficiently to injure it, even if the process of filling consume a month, with interval of days."

Mr. J. Winslow Jones, Portland, Maine.—"I think it best to be three or four weeks in filling a silo, or even longer, if it is 20ft. or 25ft. high. If you are filling several, fill a foot or so a day; and if a day intervenes it is all the same. The fodder should be kept level and trod very hard, and every morning, before any new is put in, it should be thoroughly trodden."

Mr. Jacob Pugsley, Wassaic, New York.—"No harm seems to ensue if silo is two weeks or more in filling, providing ensilage is well trodden and packed as put in."

Mr. W. M. Vilas, Burlington, Vermont.—"It is important to have the fodder spread evenly and well packed as it is put in; 6in. to 1ft. in depth put in each day will do."

It need hardly be stated, that the weights are not put on at night and taken off in the morning, as some of our experimenters consider to be so essential.

When, through delay in the filling, the surface of the fodder in the pit shows symptoms of dryness, some American writers advise that it be sprinkled with water by means of a garden watering-pot; and thus they seem to be adopting the German practice described in the "Journal of the Highland and Agricultural Society" nearly half a century ago. It is not advisable, however, that the water should be applied too copiously, as it would run through to the bottom instead of remaining where it is wanted. A slight sprinkling, repeated several times at short intervals, would be much better than putting on the same quantity of water all at once.

Mr. G. Fry, of Chobham, Surrey, whom we have quoted at considerable length at page 349, although an advocate of slow filling, would be very unlikely to adopt such a practice as watering the fodder to keep down the heat, as he is in favour of a development of active fermentation by reduction of moisture. But such a process as he recommends could hardly be carried out in wet weather, when the advantage of the silo is greatest; and when it can be carried out, it is questionable whether it is likely to prove more beneficial than the course generally adopted. We shall therefore have some observations to make on this point in Chapter IX., with respect to "Losses by Fermentation" (page 149).

In concluding these remarks on slow *v.* quick filling, we may say that, where it can be conveniently carried out, we should prefer to adopt the slow process; and we certainly should not go to the trouble and expense of lifting on and lifting off so many tons of weights night and morning.

There is one inconvenience, however, with regard to slow filling, and that is, that it would be very troublesome for the owner of a single silo of limited dimensions to cut and put in a small quantity of grass day by day, and thus tediously spin out the process. Under such circumstances he can scarcely do better than fill the pit at once, and put on the weights, and at some convenient time afterwards, when the mass has well settled down, lift off the weights and boards, and fill up again to the brim.

"CURBS" OR "SUPER-SILOS."

To facilitate the filling of the pit, or rather to avoid the trouble of refilling, some American siloers make use of a wooden superstructure, which they call a "curb" or "kerb," by means of which they fill in the fodder for some feet above the height of the regular walls, and when the mass has sunk down sufficiently this temporary portion is removed. In many cases, although the silos have the lower part of the walls built of concrete or stone, there is only a thin boarding on the top, evidently to answer a similar purpose, *i. e.*, to obtain a complete filling of the solid portion of the structure. In the official report of the Department of Agriculture, it is stated that "a temporary curb is sometimes added to the silo proper, so that the latter may be full when the settling ceases;" and in the individual returns we find the curb mentioned as being 3ft., 4ft., and even 6ft. in height.

Mr. Kenyon was one of the earliest to adopt a similar method in this country; for he says (page 309), in his account of his experiments of 1881, that "by fixing up a sort of movable frame of planks around the top of and flush with the brickwork, we were able to cram in seven loads more grass." Mr. Swan (p. 292) used his floor-boards for a like purpose; and Mr. Solomon (p. 285) employed some deals in a similar way with his earthen pit. At Merton it was one of the improvements adopted last season, and Mr. Woods thus describes it in his South Kensington lecture: "This contrivance is what I may describe as a small super-silo,—an oblong two-inch deal box, without bottom or lid, about 30 inches in depth; the sides and ends, which are separate and apart, being brought together and affixed by ordinary bolts and clamps to the wooden coping and walls of the silo proper, and the sides strengthened against lateral pressure by a few iron struts." Mr. Grant (p. 227) attains the same end in a different fashion, for he piles up his blocks of concrete on the walls, thus adding 3ft. to the height of his silo; and, as the mass sinks he rolls the blocks over upon the boards.

The Use of Salt.

Salt has often been recommended as a preservative of the crops put into the silo, and some persons have used it in inordinate quantities. But if the ensilage process is properly carried out, and the fodder in a sound state, salt is needless for preservation; and, on the other hand, if these conditions are not complied with, salt alone will not suffice to remedy the defect. M. Goffart's opinion, in answer to the question, "Is it necessary to make use of salt in a silo?" was given as follows: "You can do without it. I often dispense with it myself, without good conservation being interfered with; but I think the moderate use of salt is favourable to the health of the animals, and I sometimes mix some with my fodder at the rate $2\frac{1}{2}$lb. to 3lb. to a ton, so that the animals may get 1oz. to $1\frac{1}{4}$oz. in their daily ration of food."

M. Lecouteux says, "I no longer employ salt, experience having demonstrated that it is not required in order to obtain good fermentation." And Dr. Thurber says that in America the use of salt is generally abandoned.

In Lord Walsingham's first ensilage experiment (page 260) not only was salt mixed with the fodder at the rate of 1lb. to the cwt., but a layer of salt one inch in thickness was spread over the surface before covering up the mass. When the silo was opened, instead of the herbage being well preserved, it was rotten for a depth of four or five inches. This unsatisfactory result was thought to be due to the grass and clover having been pitted when wet with rain. But grass and clover have been put into the silo elsewhere when saturated with rain, and yet have kept well; and the probability is that the bad result in this case was due to the layer of salt. This would at once destroy all vitality in the herbage, and make it an impenetrable mass, through which the air within could find no exit, and, being thus shut inside, it would produce decay. In the second experiment (p. 261) the quantity of salt mingled with the fodder was raised to 2lb. a cwt. The silage was good, not because of the large quantity of salt—for excellent

preservation has been obtained without any salt whatever—but probably because a large admixture of salt, when evenly scattered throughout the mass, is far less detrimental than a similar quantity placed in one layer upon the surface.

It will be seen above that M. Goffart considers from 1oz. to $1\frac{1}{4}$oz. a sufficient amount of salt in a day's ration of silage, of which he gives to his cows from 60lb. to 70lb. per diem. In similar quantities containing the proportion of salt above mentioned (2lb. to the cwt.) the animals would receive a pound or more of the condiment. It is not surprising that the effect of this is not always beneficial, especially with dairy stock; for, although small quantities of such provender, when mingled with an abundance of other food, might be used without deleterious effects, a large supply of the silage would have a tendency to dry up the milk and cause a falling off in the condition of the animals. Lord Tollemache found (p. 248) that, with 30lb. of silage, containing this proportion of salt, the milk diminished considerably, and he accordingly reduced the quantity one half, when the milk increased again. In Lord Fortescue's experiments (p. 240) the salt added was only about 1lb. per cwt., or half that previously mentioned, yet the animals that received 50lb. of silage a day lost condition and fell off in the milk supply, although those which received two-thirds of that weight did well.

When one considers that the silage is, as a rule, three-fourths water, one may see that the addition of 2lb. of salt to the cwt. would produce provender that would be something like a mixture of 28lb. of well-salted hay with about eight gallons of a liquid nearly as salt as sea-water, though not exactly the same in all its ingredients.

We are glad to find that, among the recent modifications in the Merton practice, mentioned by Mr H. Woods in his South Kensington lecture, is the reduction of salt. He said: "Another alteration, and also an undoubted improvement, is a reduction in the allowance of salt; a matter in which I believe mistakes to have been made. After careful observation I am not prepared to concur with those who would dispense

altogether with the use of salt; but, so far as I am at present able to judge, the proportion should be about $\frac{3}{4}$lb. and in no case more than 1lb. to every cwt. of the fodder."

But even this quantity would be too much where the silage is used very freely; and it will be seen on page 160c that M. Nivière gave as much as 130lb. a day to beasts he began to fatten. We prefer the practice of those who give the silage unsalted, and place in the manger a lump of rock-salt, which the animal can lick at discretion. By so doing, they spare themselves the trouble of mixing when the silo is being filled, and give the animal the opportunity of stopping the salt without stopping the food. Such is the practice of men of experience, as will be seen by reference to the letter of Mr. Grant (p. 228); while Mr Kenyon (p. 312) writes:

> With respect to salt, a good deal of misapprehension seems to exist. Its liberal use is evidently regarded by some as indispensable to the production of good ensilage. I held much the same opinion three years ago, but it has been dispelled by experience. I should say that if this substance exerts any influence at all on the process, it is certainly not a beneficial one. As a condiment or a corrective I believe it is a good thing for stock, but I prefer to give it them separately, in the form of rock-salt, which they can lick or not, as their tastes or instincts prompt them. In 1881 I mixed a considerable quantity of salt with the grass as it was thrown into the silo; in 1882 I only did so with about half of the ensilage; and last year I discarded it altogether. If the quality of my ensilage is no better in consequence, it has certainly suffered no deterioration by the omission.

Trampling Down the Fodder.

M. Goffart strongly advocates trampling down the fodder when filling the pit, yet says it is of less importance than efficient weighting. Some persons use horses or cattle for this purpose, or have carts or rollers drawn over the mass; but animals cannot tread close up to the walls, where the trampling is most needed. Mr. Woods (p. 261) recommends well ramming with wooden rammers—a method mentioned in the old German practice described at p. 10.

CHAPTER VI.—COVERING AND CLOSING THE SILO.

SOME persons have advised that in packing the fodder in the pit, it should be piled up in the centre at the finish; but the experience of M. Goffart is that such an arrangement is detrimental to good preservation, and he says on this point:

> The filling of the silo should be carried out in such a manner that the layer of fodder should always be horizontal. The trampling down alongside the walls (which ought to be as smooth as possible) is carried on whilst the silo is being filled. A person going constantly round as close as possible to the walls suffices for this operation. The topmost layer in the silo should be made perfectly flat, and not higher than the level of the wall. To ridge it up in the centre is a grave error; the mass cannot be sufficiently compressed, and dry rot sets in, which is not long in communicating itself to the mass below.

The filling having been completed, the covering up takes place. Some of the American farmers put nothing whatever between the boards and the fodder, thinking it unnecessary; and such a course is preferable to the use of anything close and compact, which is likely to mat together and become impenetrable, because, with a layer of this kind, air is shut in which ought to be expelled. M. Goffart says:

> The most important question—and one without which there can be no good preservation—is the covering up of the silos. A layer of dry straw, an inch or two in thickness, should be spread evenly over the green fodder; this straw should be covered with boards, and, finally, upon these boards should be placed heavy materials to the extent of about 100lb. per square foot of surface. Thinnish boards, such as battens, suit better than thicker deals, because they give more to the inequalities of settlement, which are difficult to avoid.

But better even than straw, in M. Goffart's opinion, are the "needles" or leaves of pine-trees, where such can be obtained. In the forests in the Sologne district they are in great

abundance, and M. Goffart utilises them largely as bedding for his stock, by which means he is enabled to chop up his straw and mix it with the cattle food. As to the use of these pine-needles for covering up the fodder, he says:

The best covering consists of the newly-fallen needles from pine-trees: the great quantity of resin which they contain prevents their decomposing quickly, whilst soft straws, and especially after-maths (which are commonly employed) are rapidly softened and decomposed by the vapour which escapes from the lower layer of maize and converts it into a mere dung-heap. This mass becomes impermeable, and completely imprisons the vapour which, for want of an outlet, remains at the top of the layer of maize, and sets up the mouldiness which soon renders it unfit for feeding beasts.

In short, make use of pine needles if you have them at your disposal; if not, don't cut up the straw that you are about to employ, but use it whole, and choose in preference the hardest you can get, such as will the longest resist the action of moisture. Here rye straw stands in the first rank; next comes wheat straw, and then oat straw; after-math grass should be utterly proscribed.

Never lose sight of the fundamental principles which assure success in ensilage—continued pressure to expel all the air contained in the silo. This air, at the time when you have rapidly carried out the process of ensilage, represents at least one half of the cubic space occupied by the pitted fodder. Leave this air in contact with the material, and it will end in the whole mass undergoing serious damage.

The vapour which escapes more or less freely from the pitted material, according to temperature of the latter—which is always disposed to rise a little at the upper part of the silo—is equally a cause of deterioration when the vapour is imprisoned. But, on the contrary, it is harmless when it finds an outlet among the stones and bricks which form the covering.

Mr. Oakeley (p. 313) used a layer of heather between the grass and the boards, and others have also found it serviceable. Gorse, fern, reeds, and various other matters may be employed for this purpose—hard, tough materials being better than soft.

Some persons take a good deal of pains to make the surface impervious to air. In Mr. Stobart's silo strips of zinc were placed under the boards in order to close the crevices. Mr. H. Woods recommends (page 261) that a layer of bran be spread *above* the boards. This is a much better arrangement than putting it under them, for it will not shut in the

air to the same extent; and it is far preferable to some other methods of excluding the air. Mr. Gibson uses cavings for the same purpose; and both are better than sawdust, which others have made use of. Sand is objectionable from the probability of its running through crevices and getting mingled with the food.

The Covering Boards.

These are ordinarily boards of 1½in. or 2in. in thickness; if thicker they do not adapt themselves so well to any inequality in the packing. They should cross the narrow way of the silo, and be half an inch or an inch short, so as to sink freely down without any obstruction. The small amount of vacant space is not objectionable with heavy weights—indeed, it is an advantage rather than otherwise, as it permits the air to escape as the fodder settles down. For the same reason, it is not requisite that the boards should fit very closely together on the top. Some persons have had their boards tongued and accurately matched together, so as to form large sections several feet in width; but these are disadvantageous for several reasons. They are not so readily handled; they do not accommodate themselves to any inequalities in the mass; a larger portion of the surface has to be exposed in cutting out; and, finally, although they may serve better to exclude air, they also are more effectual in keeping air in.

Mr. M'Connel (page 323) used small pieces of board only about 40in. long and 11in. wide, laid about half an inch apart to admit of the escape of air; and he found these small boards, with iron weights on them, very handy.

As M. Goffart says, when the silos are deep, the cost of the covering boards is not of much importance, but when they are shallow the cost per square foot should not be lost sight of. In Mr. Ford's estimate (page 221), the cost of 105 sq. ft. of 2in. battens is put down as 1*l.* 15*s.*, or 4*d.* per square foot, which seems rather high. Those of Mr. Willan (page 235) cost a little more than 3*d.* per sq. ft.; thinner boards would be cheaper, and some 1½in. boards are spoken of as costing

2*d*. per square foot; but, of course, price varies with the locality.

Closing the Doorway.

In silos that are wholly or partially above ground, there is usually a doorway. The closing of this is a matter that requires some degree of attention; and the nearer the door is to the bottom of the silo the more carefully should it be attended to. M. Goffart experienced some trouble in this way, and made various changes with a view to get over the difficulty. He found that thin boards warped under the action of the damp, and let the air penetrate. He replaced them by small beams or bars of wood about 4in. square, made to fit closely, and to slide in vertical grooves placed one on each side of the doorway. These bars did not warp and leave crevices between them as the boards were apt to do, but, by keeping their shape better, they shut out the air much more effectually, and the damage decreased accordingly. With his last silos, however, he adopted a still more certain method of excluding the air, viz., temporarily bricking up the doorway. He says: "I now close the entrance of my silos by means of temporary brickwork plastered inside with hydraulic mortar; and this wall is pulled down again at the time of opening the silo. This brickwork closes the opening much more effectually than the boards, whatever care may be taken to adjust them one upon another. Each opening may be closed up by a bricklayer in the course of an hour or two."

As previously stated, the doorway should be so placed as to cause the least possible exposure of the contents of the pit to the action of the air, and therefore it should be at the end or narrow way of the silo. The middle of the long wall would be the worst place, because, on cutting into the mass, it would be exposed on both sides. If made in the long wall, the best place would be at one corner.

CHAPTER VII.—WEIGHTING THE SILO.

THIS is a point on which M. Goffart insists as more essential than any other part of the process, and some of his American disciples far outdo their master, as they state that they put on four or five times as much weight as is recommended in the following extract, the *italics* of which are in the original:

It is indispensable to put on the cover or movable planks of the filled silo about 100*lb. per square foot of heavy matters, such as stones, &c.*

Here I come to the most important point—which I have had the most trouble in determining, and which I have only lately settled. When a silo has just been filled, it is not merely necessary to exclude the outer air, it is requisite in the first place to expel the mass of air which is shut up in it. This is the part which the heavy weights put upon the silos have to perform, and by means of which I attain the desired end.

A layer of clay, which hermetically seals up the pit, is exactly opposed to this object. It is necessary that the air inclosed in the silo should find means of escape between the planks above; it is necessary that great pressure should drive out the air as quickly as possible from the place where its presence would cause most serious mischief.

This great pressure ought to continue for several months, because the trampling down at the time of ensilage, however thoroughly carried out, is not in itself sufficient. At the time when the green fodder is chopped up, it is still living, and endowed with such elasticity that it reacts strongly against the momentary pressure which you have put upon it. It is not the same, however, after a few weeks or a few months; the fodder soon undergoes a softening which diminishes the elasticity, or, in other words, increases its compressibility to a considerable extent.

It is when these physical and chemical modifications are accomplished that the heavy weights, which I have indicated as an indispensable condition to success, produce their salutary effect. They follow the fodder as it collapses, and produce that state of very high density which is necessary to put it beyond the reach of deterioration.

Some American farmers, however, state that the juice of the maize has been squeezed out by 100lb. pressure; but it is not improbable that this result may have been due to the

maize being in an exceptional condition. M. Goffart states that he never found the juice of the maize squeezed out except in one instance; then it had been left until too ripe, and had been exposed to rain and frost, and the juice ran out from the mere weight of the fodder, before any other pressure was put upon it. Mr. Bateman mentions (page 26) that his maize parted with its juice at a very low pressure; but here, too, it had been affected by the weather.

It seems pretty clear that, under certain circumstances, a breaking-down of the cellular tissue in plants occurs, and the juices thus escape much more readily than under normal conditions. Unless such be the case, it is difficult to account for the conflicting reports which occur as to the amount of weight used, and the effects produced. On the one hand we read accounts of comparatively light weights being put on, and the juices being squeezed out of the fodder; in others several times as much weight is reported to have been used with beneficial effect. For example, Mr. Fraser says (page 290) that he applied a pressure of "something like 500lb. per square foot," and attributes the good results to this heavy pressure. Somewhat similar statements appear in the American official report. Some men state that they used 300lb., 400lb., or 500lb. per square foot, but make no mention of juice being squeezed out; whereas another says: "We used 100 pounds per square foot (too much); floor of silo covered with expressed juices of forage."

The fact should not be overlooked that the weight which is put on the top of the mass is but small in comparison with the pressure upon the fodder at the bottom of the pit—from which the juice would be most likely to be driven out, if driven out at all; and an increase of a yard in the depth of the silo would have greater effect on the pressure at the bottom than a difference of 100lb. per square foot in the weight upon the top. In many American silos the depth is 20ft. or more, some being as much as 25ft. In such a case the pressure at the bottom, from the superincumbent mass, would be at the rate of about half a ton to the square

foot, without the addition of any weight upon the surface. The surface pressure is chiefly requisite for the purpose of keeping the *top* layer in sound condition, and thus preventing deterioration from being conducted from the surface downwards; and in shallow pits it is of much more importance than in deep silos, where the great bulk of the silage is kept in good condition by its own specific gravity.

In some of the instances where there has been much liquid found in the silo, it has probably been due in great measure to the wetness of the fodder when put into the pit. From Mr. Stobart's silo 50 or 60 gallons of liquid were drawn off; and it appears from the report (page 298) that "the pit had been filled regardless of weather, and it rained during the whole of the three days the men were at work." But in some instances, with underground silos, the supposed expression of juices has been imaginary. In one case in America, where the bottom of the pit was thought to be swimming with the juice of the fodder, the liquid was found to be due to a leakage of water which ruined four or five tons of the silage. Dr. J. T. Smith, at the Chicago Congress, said, "There is more trouble in keeping water out of these underground pits than there is from the water getting away from the corn fodder." M. Goffart says (p. 108) that he had a lot of silage spoilt by a crevice letting in water. An instance of such leakage is related by the Rev. C. H. Ford at page 223; and we think it very likely that various complaints of juice in the pits have had their origin in unobserved crevices, for liquid seems to be more prevalent in underground silos than in those that are above ground.

In some instances, where there has been much liquid in the pit, it has been found convenient to have a tap to draw away the liquor, as mentioned by Mr. Easdale (p. 207). In one of Mr. Oakeley's silos (p. 313) some liquid was also drawn off; but in other cases, where there have been taps, there has been found none to remove. Mr. Grant shows (p. 230) his arrangement for collecting the ooze in the pit, so as not to inconvenience the men when cutting out the fodder. Where there

are taps, our impression is that it is best not to draw off the liquid till the cutting out takes place; but this is a matter that can only be definitely settled by further experience.

Cost of Weighting Apparatus.

A considerable item of cost will be weights, if they are purchased. In the estimate of Mr. Ford's silo (page 221) it will be seen that concrete blocks for weighting form about one-fourth of the whole outlay, and the tackle to facilitate the moving of them costs nearly half as much as the blocks. In none of the American estimates do we find any mention of expenditure in this respect. Anything available is turned to account—blocks of stone, barrels of earth, sacks of grain, casks of cider, logs of firewood, kegs of water—in short, any heavy stuff that may be upon the farm. Barrels form a favourite vehicle for the weight, all sorts of substances being packed therein; and as they can be readily rolled about, and whipped up by means of slings or falls, with a horse to pull a rope running over a block, the process of loading is quickly accomplished. On this subject M. Goffart says:

When silos are of great depth, the cost of planks is not very important; but when the silos are shallow, the price per square foot should not be lost sight of, for it may become a rather heavy item. At all events, it would be a matter of importance to get rid of it, and I am going to try some experiments for this purpose. I shall dispense with planks in one of my silos, and shall merely place some well-burnt bricks upon the bed of straw, so as to form a compact layer of sufficient height to give the weight of about one hundredweight per square foot. My silos have a surface of 500 square feet, and my bricks weigh about 5lb. each, therefore 10,000 bricks will be required for each silo. The bricks would cost some 8*l.* or more, but would have the same value after as before the temporary use to which they are put. Bricks in any case will be better to handle than lumps of stone, the irregularities of which make the work painful and slow. Of course it will be requisite to have well-burnt bricks, so that there should be no fear of breaking.

If I had silos in England or Belgium, where pig-iron can be obtained for about 40*s.* a ton, I would not hesitate to get blocks cast of such shape that they would lie sufficiently close together. To be convenient for lifting, they might be about 3in. thick, and cast with a handle, as in the large weights used with scales. In this way a very useful method of rapid shifting might be obtained.

I need not say that weights once lifted to the top of the silo ought not to be taken down: they should be placed on the surrounding walls.

Those who have stone-quarries near at hand would probably have the opportunity of buying rough-hewn stones, with an even surface, and 10in. or 12in. thick. Supposing they have a mean density of 100lb. to 120lb. per square foot, a single layer would give sufficient pressure, Old paving stones might, in certain cases, be used advantageously, especially when they are nearly cubical in shape.

I intend to employ three different modes of covering my silos—(1). Rubble stones with old rick cloth put under them, so as to prevent the stones getting mixed with the fodder. (2). Bricks without boards. (3). Placing upon boards the sacks of phosphate intended for my manure heaps. But, as with everything else, advantage should be taken of local resources, whatever may be most economical, but without losing sight of other conditions of good service, for nothing would be more dangerous than a mistaken economy with regard to means of compression.

Mr. Stobart (as will be seen by Mr. Easdale's letter on page 207) has adopted blocks of pig iron as weights; and others have followed his example. Mr. Easdale stated in the *Field* that these blocks are cast to a model made with a view of their being convenient for lifting, and have clip-holes for grapples to lay hold of. They are 18in. long, 5in. wide, and $4\frac{3}{4}$in. deep, and each block weighs as nearly as possible 1cwt. A single layer of blocks placed closely side by side gives a pressure of $1\frac{1}{2}$cwt. per square foot. They were delivered at Cowton station at 45*s*. per ton; but since then, the price of iron having fallen, they have been obtainable at 39*s*. per ton, to which, of course, carriage would have to be added.

The Duke of Hamilton (page 271) adopted bricks for weighting purposes, at a cost of 50*s*. per thousand, or 17*s*. per ton, a thousand weighing about three tons.

Mr. Grant (p. 228) and others use blocks of concrete; while others, again, have square boxes filled with clay or pebbles.

Many persons are naturally anxious to avoid the trouble and labour consequent on the use of heavy weights; but the difficulty has generally been to find anything that will answer as well, and with as small an amount of attention. Commissioner Loring's American report says, pithily: "Screws are used by some instead of weights. The objection to them is that they are not self-acting, like gravity." Consequently,

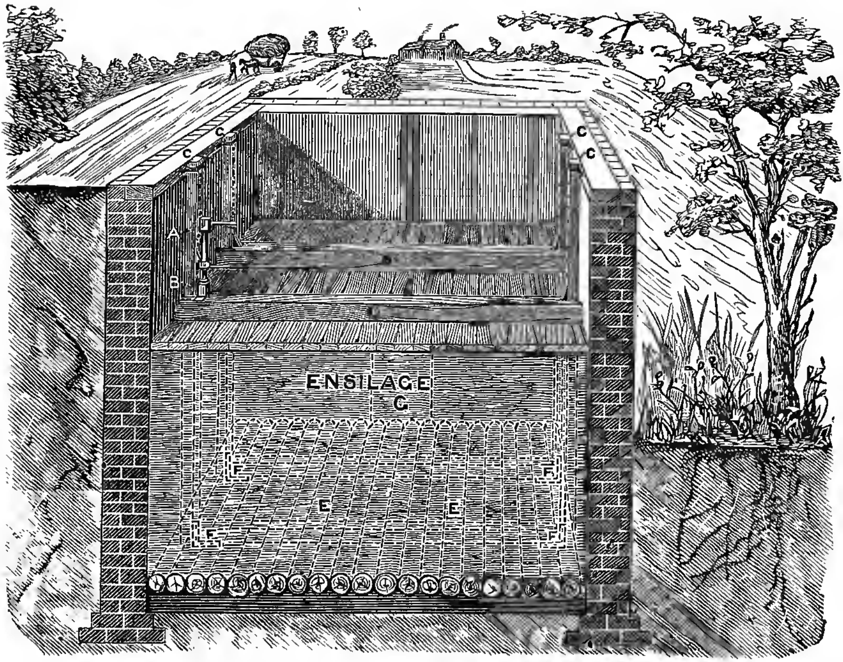
if they are not watched, and screwed down from time to time, the pressure may be lost as the fodder sinks, and the air will get in and produce mischief.

Mechanical contrivances will answer, beyond doubt, if they are properly attended to; for we have seen several excellent samples of silage pressed by their means. Nevertheless, we think it more than probable that the majority of farmers, and the men in their employ, will not attend to all the details with the same amount of care as the inventors of the various kinds of apparatus; and machinery of this kind has yet to pass through the ordeal of ordinary farm practice before it can be said that it fully answers the purpose for which it is designed.

It will be well for persons who are thinking of investing in one or other of the various methods for pressing siloed crops, to consider whether they are prepared to give the apparatus the amount of attention necessary to ensure success. If they are, they may find their investment profitable in the end, because it will save labour; but if they think of adopting the machinery with the idea that it will save them personal trouble, they possibly may find themselves mistaken. The crops that are put into the silo do not behave exactly alike in all instances; not only are there different kinds of crops, but the same crops vary in condition, owing to the state of the weather and other causes. Goffart has pointed out that, in the spring, when the temperature rises, fermentation at times sets in with great energy, and the mass of silage sinks considerably. We have known a similar thing to occur, where some grass, rather heavily weighted, had for a long while shown no indication of settling down further than it had done in the first week or two after being pitted; but, on a rise in temperature, a further considerable shrinkage ensued, and the weights naturally sank down as the mass subsided. If, however, a similar thing should happen in a silo with mechanical pressure, it is not improbable that such a shrinkage might occur without attracting attention, and the silage be left without any surface pressure. The advantage of dead weights in cases of this kind is unquestionable, as they are always in operation.

However, as before stated, mechanical appliances can be made to answer well if they are properly looked after. One of the methods which has given very successful results is that invented by Mr. Johnson, of Croft, and described with illustrations at page 210. That process is not patented.

Another, which also answered well, is one patented by Mr. Potter, clerk of works to Lord Ashburton, and manufactured



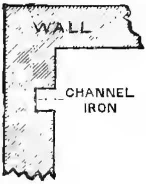
Potter's Compressing Apparatus with Hydraulic Jack.

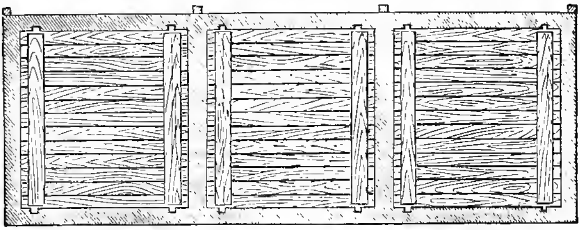
by Messrs. Reynolds and Co. of Edward-street, Blackfriars-road, London. It is shown in the above woodcut, and was applied to Lord Ashburton's silos depicted at page 59. The following description of the appliances is given in the "Journal of the Bath and West of England Society."

In the walls of the silo, near the angles of each compartment were built channel iron standards, each having a powerful claw at bottom going through the wall. Every 6 inches apart in the height, projecting "fangs" were riveted to the standards, each capable of resisting a force of

six tons; the fangs were not allowed to project beyond the face of the wall.

A hydraulic jack was provided with a foot at the bottom that would pass under any of the fangs as required, and the ensilage materials being ready for pressing, the whole area of the silo was covered with 9in. by 3in. planks, leaving a space of about ¼in. between them for air to be expelled, and being also about ½in. short that they might not pinch the walls. Across these planks were laid two others, 11in. wide and 7in. thick, their ends abutting against the channel-iron standards. The jack being placed on one of the ends of these transverse timbers, with the foot placed under one of the fangs (the latter being the point of resistance) the pressure was applied with the jack handle, and the contents of the silo were rapidly depressed. When no more depression seemed obtainable, a





wedge was put into the place occupied by the foot of the jack, and the jack then withdrawn and shifted to the opposite standard, and so on, till the four had been acted upon.

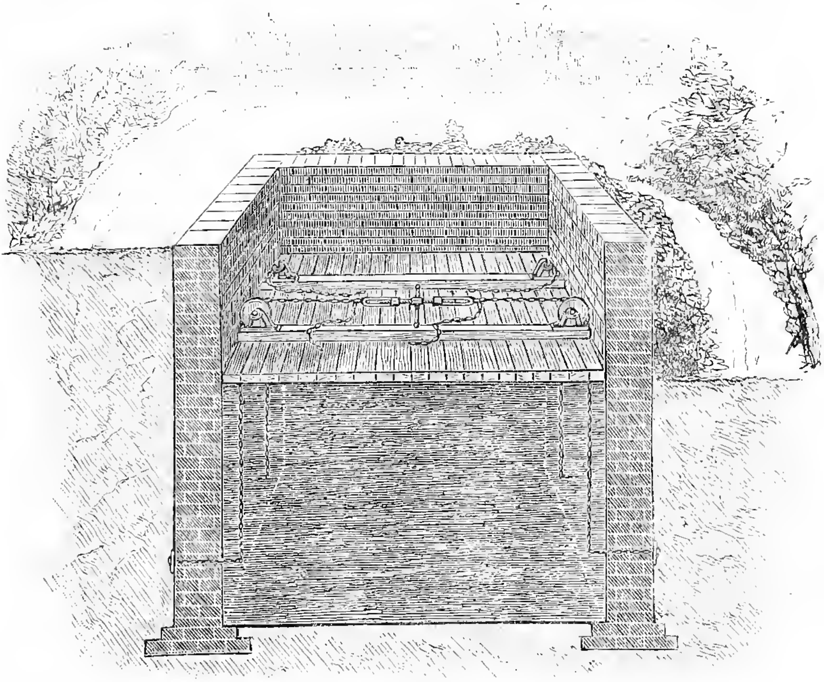
The operation was repeated each succeeding morning for about a week after the last batch of ensilage materials had been deposited, when further compression appeared to have no effect; but at later dates the pressure has been occasionally applied and the ensilage put still closer together. The jack was tested to 4 tons; the total compressive force was therefore not less than 16 and probably nearer 20 tons, or 300lb. per superficial foot. To apply the full force at the four points of the silo, or compartment, occupied one man ten minutes, and to release the pressure and remove the cover planks required two men a somewhat less time.

The channel irons can either be applied to the surface of the walls of existing silos, as shown at c c on the previous page, or let into the wall as represented in the woodcuts above. The cost of the apparatus is stated at page 96.

Messrs. Reynolds and Co. are also the manufacturers of another method of applying pressure in silos. The following woodcut, and the accompanying particulars from a circular issued by the firm, will give a good idea of the nature of

the appliances, which consist of chains, rollers, and screw apparatus for tightening the chains.

A chain is attached to the lower part of the wall of the silo, in any suitable manner, either by taking it through the wall with a plate and bolt on the outside, by weighting it in the ground with concrete, or attaching it to a beam; and on the opposite side of the silo a similar chain is attached. While the silo is being filled, the ends of these chains



REYNOLDS'S COMPRESSING APPARATUS WITH CHAINS AND SCREW.

are thrown over the wall or hung on spikes on the sides. After the material is put in the pit covering boards are placed over it, and a stout tranverse beam is laid on the top, stretching from side to side of the silo. In the ends of this beam brackets are fixed to carry movable rollers, over which the ends of the chains from either side are led. The chain-tightener is hooked into the links, and on turning the handle of the screw the ends of the chain are drawn closer together, causing the beam and covering of the silo to sink, and so to press the material. Pins are then inserted in a link of each chain to hold the beam down, when the screw-

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tightener can be made to take a fresh hold on the chain for further pressure, or be removed altogether. Any number of beams may be used, according to the length of the pit and the pressure required per square foot of surface; but the chain tightener and pair of rollers are removed from beam to beam, so that only one set of these is sufficient for any number of silos.

The chain-stretcher and pulleys together cost 5*l.*, and the expense of the remainder of the appliances would depend upon the number of the beams required and the length of the chains. For a silo 60ft. long by 12ft. wide and 12ft. deep, Messrs. Reynolds state that, to produce a pressure of 200lb. per square foot, eight beams would be required, and the cost of the 320ft. of chain and other appliances to work them would come to 24*l.*, thus bringing up the total for 720 square feet of surface to 29*l.* If the silo were half the length, the cost of chains, &c., would be reduced accordingly; but the 5*l.* for the screw apparatus would remain as before. This does not include the cost of the covering boards, which would be the same as in any other silo of the same dimensions; but the beams would be an extra outlay.

Mr. Stocks' mode of applying pressure is described at page 77. The press and springs can be applied to a silo 20ft. by 10ft. for 18*l.*

Messrs. Pearson and Co. give the cost of their arrangement of continuous pressure, shown at page 73, as 18*l.* for a travelling crane for 60ft. by 12ft., and 12*s.* per ton for concrete blocks; or at the rate of 2*l.* 10*s.* per 100 sq. ft. of surface, with a pressure of 1cwt. to the sq. ft. Their arrangement for mechanical pressure, shown at page 85, costs for four sets of winders, &c., for a stack 18ft. by 10ft., 8*l.*, or at the rate of 4*l.* 10*s.* per 100 sq. ft.

A method of using ordinary screws and nuts, as adopted by Mr. J. Mead, is represented at page 243.

The suggestions that have been made for applying pressure to silos are so numerous as to defy description. They would almost fill a volume in themselves. Many are evidently impracticable, and of others it is not desirable to say anything until they have been submitted to the test of practice.

CHAPTER VIII.—OPENING THE SILO.

On the door being opened, as little as possible of the silage should be uncovered, only a sufficient number of boards being removed to give room for the operation of cutting to be performed. It is usually cut in vertical sections, as is done in a haystack, as much being taken out each day as is required for the day's consumption. The weights should not be removed from the uncut portion until absolutely required for the work to be done, as pressure is even more necessary after the opening than before. When weight was deficient M. Goffart found the ensilage deteriorate very rapidly after opening; and one of the American farmers, in reporting to the Board of Agriculture, says: "In opening our silos we took all the stones off; this was a mistake, as we lost about a ton apparently from the want of sufficient pressure to exclude the air." Another American farmer adopted a much wiser course when, instead of removing the weights altogether, he shifted the weights from the boards to be lifted and piled them on the others not yet wanting removal, thus increasing the pressure during the opening; and he says that the ensilage taken out last was better than that taken out first.

Where the weights are removed and the silage taken from the surface alone (as is done in some silos that have no door in the wall), the danger is much less than when all pressure is taken off and the mass cut vertically from an open door. Such a course has been adopted by some American farmers, and by a few in this country. But it should only be done where the silo is small and deep, with a quick consumption, so that the entire surface can be quickly cleared off. In a broad and shallow silo, with slow consumption, it would be very impolitic to attempt this method.

In hot weather there is greater liability to deterioration than in the winter months, and the heat affects silos above ground more than those which are below. For this reason M. Goffart, although he acknowledges the advantages of above-ground silos, recommends that silos be built half underground, and he adopts the practice of cutting from the top down to the ground level in cold weather, and leaving untouched for the hotter season the lower portion, as shown in the illustration on page 53.

One of the American farmers recommends, for the purpose of facilitating the cutting out the upper half of the contents of the pit, that a layer of boards be placed in the middle of the fodder while it is being packed. There can be little objection to this course; but much the same advantage would apparently be obtained by taking the boards removed from the top and placing them underfoot, when the cutting has descended to the required distance. The settlement would probably be more regular, and the expense of a double set of boards would be avoided.

Another American farmer makes the following suggestion with respect to the emptying of the silo: "Let me suggest a convenience for those whose pits are partially below the surface of the ground at the lower door. My own silo is 5ft. below the surface at this entrance, and I have therefore made a set of trestles, with legs 5ft. in height; after the first section of ensilage has been cut back from the door, two trestles are put in, and the planks previously removed from the top of that section are placed upon the trestles, thus forming a false floor, on which a cart or the mixing trough can be run in from the level of the ground. After the removal of another section of ensilage, a second pair of trestles is placed in position, and the floor continued, and thus on to the back of the silo; so that a cart can be backed in to the very rear as conveniently as though the bottom of the silo was on a level with the ground."

CHAPTER IX.—EFFECT OF ENSILAGE ON FODDERS.

The effect which ensilage will produce on the fodders put into the pit will mainly depend upon the manner in which the process is carried out. Undoubtedly there may be a very great deal of waste if the work is badly done; and it is not surprising that persons who have seen the bad results, and not the good, should utter words of warning or condemnation.

Fermentation can be no more carried on without consuming some of the material fermented, than a fire can be made to burn without consumption of the fuel by which it is fed. In both cases combustion is going on, and the more abundant the supply of oxygen the more rapidly the burning proceeds. If you stop the draught, a fire will languish and die out; and a similar result is produced in the silo if you lessen the supply of air by the imposition of heavy weights.

Many persons seem to think that the course most requisite for the conservation of the fodder is to make the top of the silo air-tight. But exclusion of air from without is of less immediate importance than expulsion of the air which is within; and if the top of the silo be hermetically sealed as soon as the fodder is pitted, more harm than good will be done, as air will be shut in that ought to be allowed to escape. When the crop is first put into the pit, more than half the space occupied is filled by air; and if the fodder is to be maintained in good condition, this should be driven out as well as kept out; for, unless such is done, a process of slow combustion will go on, which will attack first the most nutritious ingredients of the plant, and, unless checked, will end by destroying the mass so far as its feeding value is concerned. Heavy weights effect the double purpose of driving out air and keeping it out;

whereas hermetically sealing the top of the pit, even if it can be done, only effects one purpose, and that the least important. In his early experiments M. Goffart closed the top of his silos with clay, and he thus relates the consequences:

> Having successively filled my silos, and had the layers trodden down by persons dancing on them with very great energy, I placed on the surface a layer of straw chaff about four inches in thickness, and on that a layer of adhesive clay carefully beaten down, so as to prevent any communication between the ensilage and the outer air. During the next few days, I closed, every morning, any cracks that were to be found in the covering.
>
> When, at the end of a few weeks, I proceeded to open a silo thus treated, I invariably found a space of an inch or two between the silage and the clay covering. No matter how forcibly the maize had been rammed down, there had been a further settlement, and the upper portion had undergone deterioration which would rapidly be communicated to the layers beneath. To prevent such a result, I had no other course but to get my silage consumed as quickly as possible.
>
> Subsequently I abandoned the clay as a covering for my silos. Immediately after treading down my mixture of maize and chopped straw, I placed over all a cover made of oak, exactly shaped to fit the silo, and descending with the fodder as this settled down. This simple change produced a decided improvement, though still insufficient—the mischief was only deferred for a while; but I was upon the right road.
>
> Nowadays I still make use of the same silos, and I obtain complete preservation for an indefinite period of time. The chief point of difference is this: I place upon the cover of my silo, as soon as it is filled, about a hundredweight of stones, &c., for each square foot of surface.

That fermentation can be checked by heavy weights on the fodder is proved by experiment. It is a common thing for silage to have an alcoholic or an acid smell when first taken out of the pit. If the alcoholic flavour is very marked, there has been more fermentation, and consequently waste, than is desirable; if there is strong acidity, matters are worse still. That such results may be prevented by due care is shown by M. Goffart's experience:

> In April, 1877, I opened my last elliptical silo, which contained nearly 100 tons of maize pitted in October, 1876—*i.e.*, more than seven months before. The whole presented itself as a most compact mass of a brownish green tint; the temperature did not exceed 10° C. (50° Fahr.), and there was no appreciable odour; on being put to the mouth, the maize at that instant was quite tasteless, and the absence of smell and taste produced at first an almost unpleasant sensation.

I took out from the mass a few hundredweights for the next day's rations of my beasts; and scarcely was the maize exposed to contact with the air when it underwent a veritable metamorphosis; the brownish colour became sensibly greener, and a commencement of alcoholic fermentation was soon produced, without going beyond the limits which that fermentation ought never to exceed.

This silo was not completely exhausted till the 10th of August, and the maize remained in good condition to the last day.

It must not be inferred, however, that M. Goffart objects to fermentation under all circumstances. His object is to prevent it in the silo, but to permit it in the silage when taken out of the pit for the beasts. Within certain limits he considers the fermentation of the fodder to be beneficial; beyond those limits it is wasteful, and may become positively injurious. How he regulates the fermentation is to open the mass of silage taken from the pit, mix it with the chaff or other food to be given with it, and let it lie until it has heated sufficiently. In warm weather twelve hours may suffice, and in cold weather twice as long may be necessary. In one exceptional instance, where the fodder had been frost-bitten before being put into the silo, fermentation did not set in for two or three days. With respect to the effect of leaving it to the second day under ordinary circumstances M. Goffart makes these remarks:

I have said elsewhere that the fodder taken out of the mass ought, before being given to the animals, to be exposed to the action of the air for fifteen or twenty hours, in order to set up alcoholic fermentation. After that time (which may, however, be lengthened or shortened somewhat, according as the external temperature is high or low) the fermentation becomes excessive, and therefore harmful; the spontaneous heating produced in the stuff when it ceases to be compact ought never, if possible, be allowed to exceed 35° to 40° C. (95° to 104° Fahr.).

Two years ago I had no silos on my farm at Gouillon, and on alternate days I had the silage taken from my silos at Burtin to feed the cattle on the other farm. On the second day the heat of the silage thus carried greatly exceeded the limits that I have just laid down, and the alcoholic vapours came off so abundantly as to show the serious loss which was going on. Acetic acid, too, was not long in also showing itself.

In the North of France the beetroot pulp given to cattle in winter is sometimes very acid; and it is to this circumstance that I attribute the poor quality of milk and butter obtained from animals fed upon this food.

Losses by Fermentation in the Pit.

In the autumn of 1882 two celebrated scientific authorities on agriculture expressed opinions that were pretty strongly adverse to the ensilage process; and for so doing they were rather sharply attacked by enthusiasts in its favour. Those scientific opinions may have been originally founded, in some measure, on defective samples of silage, but it would be wrong to assume that there was no ground for the notes of warning that were uttered. Instances of serious loss, such as were set forth by Sir J. B. Lawes and Dr. Voelcker, undoubtedly have occurred, though their occurrence may not be a necessary consequence of the process. The endeavour should be to avoid such loss by following the best line of procedure, and not court disaster by setting to work in full faith that precautions are needless, and that everything must come right. Here is a portion of a letter by Sir J. B. Lawes, which appeared in the *Times* of Oct. 26, 1882:

About a year and a half ago I received a bulky volume on the subject of ensilage from the United States. The writer, who was most enthusiastic with regard to the system—which he said would create a revolution in the agriculture of the country—furnished some important statistics respecting the loss which took place in the silo. Indian corn was the substance used, which, according to the author, when put into the silo contained 5 per cent. of ash, as calculated on the dry state; while the ensilage when taken out contained 9 per cent. of ash, calculated also on the dry state. If this destruction of the vegetable matter, which amounts to about 40 per cent., extended equally over the whole crop, it would be serious enough; but unfortunately it is the substances which possess the highest feeding value that are the most easily destroyed. The heat generated, and the smell of alcohol and acetic acid, to which the author also alludes, can have had no other source than the sugar which is found so abundantly in Indian corn at the time of blooming.

Last year I wrote some articles on the subject of ensilage, which were published in the United States, and I then pointed out how serious was the loss of the nutritious portion of the plant which appeared to take place in the silo. I concluded by remarking that although, under the conditions of agriculture that prevailed in the States, ensilage might be profitably used, still I hardly thought that British farmers, who had to produce the food for their stock at a great cost, could afford to adopt a system which apparently destroyed so large a proportion of the nutritious matter.

It is beyond question that there is a loss of some of the most nutritious parts of the plant when alcohol and acetic acid are formed by fermentation; and it is beyond question, also, that in some specimens of silage these products have been found in great abundance. But it does not follow, because such facts are stated, that the loss of which these are indications are directly visible, or that the writer means it to be understood that that portion of the provender which remains in the pit cannot be eaten. The food may be readily consumed by the cattle, and may be nutritious also; but it will not contain all the nutriment that might have been there had the process been more skilfully carried out; and so far as this loss is allowed to go on, so far will it impair the economy of the process. Such a loss, however, as Sir John Lawes quotes (40 per cent.) is so enormous that the idea of some error naturally suggests itself; and, in an estimate founded solely on the increased quantity of ash, there is a possibility of error, seeing that the accidental admixture of a small quantity of earth with the sample of fodder taken from the pit would materially alter the proportion in the analysis; or an addition of salt to the fodder put in the pit would considerably change the basis of comparison.

Nevertheless there are instances on record in which carefully-conducted investigations have shown the loss sustained to be even greater than that mentioned by Sir John Lawes. At page 186, in the chapter on the Chemistry of Ensilage by Mr. Woodland Toms, will be found a table giving the results of ten experiments in which the amount of loss averaged 34 per cent. on the solid matter of the fodder put into the pit, and in one case, where a bad system of procedure was carried out, as much as 54 per cent. was lost. This, however, occurred with beetroot refuse from sugar works, in which the fermentation is likely to be much more destructive than with our ordinary fodder crops.

In the case alluded to by Sir John Lawes, the crop was maize, in which, owing to the quantity of sugar in the plant, there may also occur a considerable amount of loss from

excessive fermentation when the process is badly carried out. Some instances of such having been found to be the case are particularised in a table by Professor Moser quoted on page 180. Here several weighed bundles of maize (samples of which were analysed) were inserted at different depths in a mass of similar maize buried in a trench dug in the ground. On the trench being opened, the bundles were again weighed and analysed, so as to ascertain the exact amount of loss in each of the different constituents of the fodder. The total reduction of weight in that bundle which had been placed lowest in the trench was 40 per cent., and in that which was uppermost the weight was reduced 65 per cent.; but the greater portion of this loss was water, which doubtless had been absorbed into the soil. Of solid substance the loss was not so great as in that stated by Sir John Lawes, being 28 per cent. in the upper layer and 35 per cent. in the lower; hence that which was reduced most in total weight lost least in solid substance. To show how this loss was distributed, we will re-arrange the figures of the table, turning them into tons and hundredweights, on the supposition that each mass consisted of 60 tons instead of 6000 grammes.

	Fresh Maize.		Siloed Maize taken out (17 inches deep).					Siloed Maize taken out (34 inches deep).				
	Weight.		Weight.			Loss.		Weight.			Loss.	
	T.	cwt.	T.	cwt.		T.	cwt.	T.	cwt.		T.	cwt.
Albumenoids	0	11	0	8	or	0	3	0	7	or	0	4
Fatty matters	0	9	0	8	,,	0	1	0	8	,,	0	1
Soluble carbohydrates	6	10	3	10	,,	3	0	2	15	,,	3	15
Fibre....................	4	0	3	17	,,	0	3	3	16	,,	0	4
Ash and sand	0	18	0	16	,,	0	2	0	16	,,	0	2
Solid matter, dry...	12	8	8	19	,,	3	9	8	2	,,	4	6
Water	47	12	12	3	,,	35	9	28	9	,,	19	3
Full weight	60	0	21	2		....		36	11		....	
Loss	....		38	18		....		23	9		....	
Total.........	60	0	60	0		....		60	0		....	

Here it will be seen that, out of 60 tons original weight, the reduction amounts to nearly 39 tons in the one case and

to about 23½ tons in the other; but the 16 tons difference of loss is almost exclusively water, and the amount of nutritive material in the 21 tons of the first sample is much about the same as in the 36½ tons of the second. Consequently the one lot would be worth much more per ton than the other; and, as will be seen on reference to page 155, where the percentage of the constituents is given, and the respective values are estimated, the one sample is put down as worth 14*s.* per ton (which is just about the value of the original fresh maize), and the other as worth 24*s.* If, then, an analysis of the latter were compared with that of the fresh maize, without the reduction of weight being thought of, it might easily be supposed that the maize had been greatly increased in value by the process of ensilage. But if allowance be made for the loss of weight, a very different result is shown. The original value of the fresh maize being about 14*s.* a ton, the 60 tons would be worth 42*l.* Comparing this sum with the weight and value per ton of the two lots of silage, we have the following results:

	Value. £.	Value. s.		Loss. £.	Loss. s.
60 tons of green maize, at 14*s.* per ton ...	42	0	......	...	...
21 tons 2cwt. of silage at 24*s.* per ton ...	25	6	......	16	14
36 tons 11cwt. of silage at 14*s.* per ton ...	25	11	......	16	9

So that the two lots, although differing so greatly in weight, are worth just about the same sum total, while both fall very far short of the original value of the green maize.

It is not to be supposed, however, that this is a necessary consequence of the ensilage process. It is a result due to the process being badly carried out; and is what may be encountered, to a greater or less extent, by those farmers who think that the cheapest and easiest mode of setting to work is the best. If they put a quantity of green fodder into a pit, and get fairly eatable provender out of it, they are apt to think that every end is served. Persons not accustomed to consider the effects of fermentation often fail to appreciate the losses that may arise therefrom. What is not apparent to the eye is too often passed over as though it were non-

existent; but everyone who is in the habit of burning gas in his house would be aware that a quantity of gas, for which he had to pay, might easily escape without his being any the wiser, so far as his sight is concerned; and so it is with the most nutritious portions of the hay. It may be said, however, that if you cannot see the escape of gas, you can readily smell it, and stop the leak. True; and in like manner you can smell the alcohol and acetic acid, and thus can trace the source of mischief; but in neither case can you restore the loss. All that you can do is to endeavour to prevent loss for the future.

At page 349 is given an account of Mr. G. Fry's experiments and the method recommended by him for the production of "brown ensilage," by inducing an exceedingly high temperature. The siloed forage which has undergone fermentation of this character is certainly pleasanter to smell and to handle than that which is very moist and has not been heated, and no doubt, as a marketable commodity, it would also be likely to prove more attractive to a purchaser who judges by appearance and odour. Whether it is so nutritious for the stock is another question. This, however, is a matter which can only be satisfactorily solved by careful experiment; but *primâ facie* we may assume that the high temperatures spoken of could not be produced without the consumption of a considerable amount of fuel, and that fuel consists of nutritious matters in the herbage. Unfortunately there are no analyses of Mr. Fry's green fodders to show what portion of the constituents have been consumed; and we can do no more than put the analyses of the silage into comparison with those of other samples made from similar crops. On doing this, we find that Mr. Fry's silage takes a low position, both as regards the clover and the meadow grass; but the figures in the table on page 155 scarcely afford a satisfactory means of comparison because of the difference in moisture, which is apt to mislead one as to the relative proportion of nutritive constituents. We therefore subject them all to a common standard, and recalculate them on the supposition that each sample contained

75 per cent. of water. It will suffice, however, to give merely the nutrients, without the water, ash, &c. We insert the month when the crops were cut, as first-cuts are usually more nutritious than aftermaths. Where, in Dr. Voelcker's analyses, the constituents are not particularised, we put the figures midway between two columns, as in the table on page 155. In those relating to Mr. Fry's samples, we have added the amount of digestible fibre from the particulars by Messrs. Cross and Bevan, given at page 354; and Mr. Gibson's, where we have inserted a (?), would, in like manner, probably have to be raised to 10 or 11, if the proportion of digestible fibre were ascertained. The relative value of the different samples is stated at page 155, but it may here be mentioned that the albumenoids are worth about five times as much per lb. as the carbo-hydrates.

<table>
<tr><th>Clover.</th><th>Albumenoids.</th><th>Carbo-hydrates.</th><th>Fat.</th></tr>
<tr><td>Vicomte de Chezelles' (July)</td><td>4·59</td><td>9·33</td><td>1·04</td></tr>
<tr><td>Mr. Gibson's (July)</td><td>4·63</td><td colspan="2">4·22(?)</td></tr>
<tr><td>Mr. Fry's (June)</td><td>2·61</td><td colspan="2">12·66</td></tr>
<tr><td>Mr. Scott's (September)</td><td>2·66</td><td colspan="2">12·54</td></tr>
<tr><td>Mr. Earle's (September)</td><td>2·93</td><td>8·42</td><td>1·66</td></tr>
<tr><td>Mr. Eckersley's (September)</td><td>3·11</td><td>13·36</td><td>0·78</td></tr>
<tr><td>Meadow Grass.</td><td></td><td></td><td></td></tr>
<tr><td>Mr. Grant's (May)</td><td>3·49</td><td>10·94</td><td>0·68</td></tr>
<tr><td>Lord Walsingham's (July)</td><td>2·75</td><td>11·74</td><td>0·69</td></tr>
<tr><td>Lord Egerton's (July)</td><td>2·44</td><td>9·74</td><td>1·44</td></tr>
<tr><td>Mr. Fry's (June)</td><td>2·50</td><td colspan="2">11·86</td></tr>
<tr><td>Mr. Duncan's (Autumn)</td><td>2·57</td><td>11·94</td><td>1·28</td></tr>
<tr><td>Mr. Smith's (October)</td><td>3·30</td><td>9·45</td><td>0·99</td></tr>
</table>

Of the clover samples, that of the Vicomte de Chezelles was mainly clover with a small admixture of common grasses and barley; Mr. Gibson's was clover and sainfoin; and all the others were clover and ryegrass. Mr. Fry's (cut in June) and Mr. Scott's (cut in September) are nearly on an equality; but it will be seen, on reference to pp. 235-6, that Mr. Scott's silage from the second-cut was very inferior to his hay from the first cut. Of the grass silage, the figures after Lord Walsingham's name are the average of his three samples; and the same is the case with Lord Egerton's. Mr. Fry's sample, from grass cut in June, is also inferior to the after-

maths of Messrs. Duncan and Smith. Whether these results are due to poorness in quality of the fresh herbage, or to loss in Mr. Fry's process of ensilage, is a matter of uncertainty; but at present it does not promise well for the process. And it would be very desirable not only to have analyses made of fresh herbage and silage, but to weigh quantities of green fodder put into the pit, in order to compare with the weight taken out.

Mr. Fry says that "M. Goffart insists on the advantage of filling small quantities of chaffed maize at a time, but whether he really succeeded in obtaining the desired temperature has not been recorded. It is clear that he knew that a brisk fermentation was an advantage, but he did not know why." Mr. Fry, however, appears to have misunderstood M. Goffart, who says again and again that there ought to be no fermentation in the pit, and that "the best way to avoid bad fermentations is to let none of any kind be produced." Whether this is altogether possible is open to doubt; but he makes it perfectly clear that he intends the temperature to be low, and that the heating of the silage should only occur after it is taken out to be given to the beasts, and even then the exposure should not be continued long enough for the temperature to get very high (*see* page 143).

As far as present evidence goes, we should be inclined to adopt Mr. Fry's method if we wished to sell the silage instead of using it; but if we wanted to store food for feeding our own cattle, we should prefer to follow the recommendations of M. Goffart.

CHAPTER X.—FEEDING QUALITIES OF SILAGE.

THE amount of moisture in the silage has an effect which many people seem not to take into consideration, viz., that of diluting the nutritive material. One frequently sees general statements with respect to the feeding value of silage and the quantity requisite to be given to various animals—no regard whatever apparently being paid to the proportion of water it contains. If anyone were to assert in direct terms that 10lb. of hay given with four gallons of water would nourish a cow as well as 20lb. of similar hay with three gallons of water, he would be laughed at, or considered a lunatic—especially if he allowed the animal to drink more water at will. Yet many people apparently see no absurdity in statements of a like character being made indirectly when the dry food and water are combined. They seem to look upon a ton of siloed grass or other green stuff as though it represented a definite quantity of food, and estimate its value at so much per ton, or say that so many pounds per day ought to be given to a milch cow or a fatting bullock, in utter disregard of the fact that one sample may contain two or three times as much nutrient matter as another, but less water.

In maize and some other crops the average percentage of water is considerably higher than in grass. Obviously, then, there must be a great disparity in the value of samples of silage, even if the only difference between them consisted in the proportion of moisture they contain.

Supposing, for instance, that a sample of maize silage contained 86 per cent. of water, the dry material (in which is included all nutrient matter) could be no more than the remaining 14 per cent.; and supposing that a sample of grass silage contained 72 per cent. of water, the residue or dry

material would then be 28 per cent., or just double that in the maize. Consequently, if the feeding material were equally good in both crops, a ton of the grass silage would be worth double as much as a ton of the maize silage, because in the former there would be twice as much nutrient matter as in an equal weight of the latter. In 100lb. of the grass silage there would be 28lb. of dry matter with 72lb. of water (about $7\frac{1}{4}$ gallons), whereas, to obtain 28lb. of dry matter in the maize silage you must take it in connection with 172lb. of water (about $17\frac{1}{4}$ gallons). You might give your cattle 200lb. of the latter instead of 100lb. of the former fodder, but they would receive no additional nutriment, for the additional 100lb. woul merely be 10 gallons extra of water.

If the grass silage, instead of having the average amount of moisture, contained only about 51 per cent. of water, as in the instance mentioned by Sir John Lawes (page 160G), the contrast would be still more marked; for 100lb. of silage with 51 per cent. of water would have just as much dry material as 350lb. of silage with 86 per cent., the difference being that in the former the nutrient matter is diluted by 5 gallons of water and in the latter by 30 gallons.

Value of Green Fodders and Silage.

The difference in the proportion of water is not the only cause of variation in the value of silage; for the crops themselves differ in their chemical constituents. It has therefore been thought desirable to give some idea of the relative value of analysed samples of silage, and to place them in comparison with dried and green fodders whose value has been previously estimated by competent authorities.

In Germany an immense amount of work has been done by the professors of agricultural chemistry at the various Government experimental stations in ascertaining the digestibility and estimating the feeding value of different crops. Not only have the crops been analysed at different stages of growth, but animals have been fed on the herbage in a green state, or after it has been made into hay, or preserved in some other

fashion; and the excreta of the animals have been analysed, in order to ascertain what proportion of the food has been digested by the animals and what has been voided without being utilised. From calculations published by Professor von Wolff the ensuing table is for the most part compiled. It gives the chemical constituents and amount of digestible nutrients contained in various kinds of hay, green fodder crops, &c., together with the money value. But inasmuch as German values per 100lb. would be of little service to the English reader, seeing that prices and weights are not alike in the two countries, it has been thought best to turn those values into shillings per English ton, at the same time raising the prices to our level. At the time of doing this the current rates in the London hay market are returned as follows: "Best meadow hay, 80*s*. to 90*s*.; inferior, 50*s*. to 70*s*. Best first cut clover, 100*s*. to 108*s*.; inferior 70*s*. to 80*s*.; second cut clover, 75*s*. to 90*s*." Accordingly, the German value for very good meadow hay has been raised to correspond with 80*s*. per English ton; and this having been taken as the basis for comparison, all other fodders are raised in similar proportion, so that prime meadow and clover hays, &c., also assimilate themselves pretty fairly with our current prices.

To the estimated values of several kinds of German silage, as included in Prof. von Wolff's tables, we have added some that are American, taken from Prof. Stewart's book on "Feeding Animals," the blanks in the early columns occurring in the original. The remainder (in which blanks occur in the later columns) are founded on analyses contained in this work, in the R.A.S. Journal, Mr. Woods' pamphlet, M. Goffart's book, &c. In the absence of any special experiments to ascertain the digestibility of the silage, we have not attempted to fill up the blanks in these columns, but have endeavoured, as nearly as we are able, to estimate the approximate value of the various samples. We have also given in the first table, for the sake of comparison, the corresponding values of the green fodder before ensilage, wherever analyses of both were forthcoming.

Kind of Fodder.	Water.	Ash.	Organic Substances.				Digestible Nutrients.			Value per ton.
			Albumenoids.	Crude fibre.	Other Carbo-hydrates.	Fatty matters.	Albumenoids.	Carbo-hydrates, including fibre	Fatty matters.	
HAYS.										
Meadow hay, poor	14·3	5·0	7·5	33·5	38·2	1·5	3·4	34·9	0·5	51*s.*
„ „ better	14·3	5·4	9·2	29·2	39·7	2·0	4·6	36·4	0·6	60*s.*
„ „ medium	14·3	6·2	9·7	26·3	41·2	2·3	5·4	41·1	0·9	68*s.*
„ „ very good	15·0	7·0	11·7	21·9	42·3	2·8	7·4	41·7	1·3	80*s.*
„ „ extra prime	16·0	7·7	13·5	19·3	40·5	3·0	9·2	42·8	1·5	90*s.*
Italian ryegrass	14·3	7·8	11·2	22·9	40·6	3·2	7·1	41·5	1·4	79*s.*
Perennial ryegrass	14·3	6·5	10·2	30·2	36·1	2·7	5·1	35·3	0·8	61*s.*
Red clover, poor	15·0	5·1	11·1	28·9	37·7	2·1	5·7	37·9	1·0	67*s.*
„ „ medium	16·0	5·3	12·3	26·0	38·2	2·2	7·0	38·1	1·2	75*s.*
„ „ very good	16·5	6·0	13·5	24·0	37·1	2·9	8·5	38·2	1·7	84*s.*
„ „ extra prime	16·5	7·0	15·3	22·2	35·8	3·2	10·7	37·6	2·1	96*s.*
White clover, medium	16·5	6·0	14·5	25·6	33·9	3·5	8·1	35·9	2·0	81*s.*
Trifolium incarnatum	16·7	5·1	12·2	30·4	32·6	3·0	6·2	34·9	1·4	85*s.*
Lucerne, medium	16·0	6·2	14·4	33·0	27·9	2·5	9·4	28·3	1·0	78*s.*
Sainfoin (cut in flower)	16·7	6·2	13·3	27·1	34·2	2·5	7·6	35·8	1·4	76*s.*
Serradella „	16·7	7·5	13·5	22·0	35·6	4·7	8·5	36·2	2·8	85*s.*
Vetches (cut in flower)	16·7	8·3	14·2	25·5	32·8	2·5	9·4	32·5	1·5	83*s.*
„ (before flowering)	16·7	9·3	19·8	23·4	28·5	2·3	15·1	31·1	1·4	105*s.*
Spurrey hay, German	16·7	9·5	12·0	22·2	36·6	3·2	7·6	36·8	1·9	78*s.*
GREEN FODDER AND ROOTS.										
Pasture grass	80·0	2·0	3·5	4·0	9·7	0·8	2·5	9·9	0·4	23*s.*
Rich pasture grass	78·2	2·2	4·5	4·0	10·1	1·0	3·4	10·9	0·6	29*s.*
Grass, just before flowering	75·0	2·1	3·0	6·0	13·1	0·8	2·0	13·0	0·4	24*s.*
„ Lord Egerton's	70·5	2·1	3·0	9·5	14·1	0·8	...	...	...	24*s.*
„ Lord Walsingham's	75·6	1·6	2·2	11·4	8·8	0·4	...	...	...	16*s.*
Upland grasses, average	70·0	2·1	3·4	10·1	13·4	1·0	1·9	14·2	0·5	25*s.*
Italian ryegrass	73·4	2·8	3·6	7·1	12·1	1·0	2·3	12·6	0·4	25*s.*
Perennial ryegrass	70·0	2·0	3·6	10·6	12·8	1·0	1·8	12·2	0·4	22*s.*
Pasture clover, young	83·0	1·5	4·6	2·8	7·2	0·9	3·6	7·4	0·6	27*s.*
Red clover, before flowering	83·0	1·5	3·3	4·5	7·0	0·7	2·3	7·4	0·5	21*s.*
„ „ in full flower	80·4	1·3	3·0	5·8	8·9	0·6	1·7	8·7	0·4	18*s.*
White clover, in flower	80·5	2·0	3·5	6·0	7·2	0·8	2·2	7·9	0·5	20*s.*
Trifolium incarnatum	81·5	1·6	2·7	6·2	7·3	0·7	1·5	7·5	0·3	16*s.*
Serradella (Ornithopus sativus)	80·0	1·8	3·0	5·2	8·9	1·1	1·9	8·9	0·7	20*s.*
Sainfoin	80·0	1·5	3·2	6·5	8·2	0·6	2·1	8·0	0·3	19*s.*
Vetches, beginning to flower	82·0	1·8	3·5	5·5	6·6	0·6	2·5	6·7	0·3	20*s.*
Green maize, German	82·2	1·1	1·2	4·7	10·3	0·5	0·8	9·9	0·2	14*s.*
„ „ American	84·0	1·0	1·4	4·7	8·4	0·5	...	...	...	14*s.*
„ „ M. Goffart's	81·3	1·3	1·2	4·9	11·0	0·3	...	...	...	13*s.*
„ „ Lord Walsingham's	83·7	1·4	1·2	8·2	5·1	0·4	...	...	...	11*s.*
Spurrey, German	80·0	2·0	2·3	5·3	9·7	0·7	1·5	9·8	0·3	18*s.*
Buckwheat, in flower	85·0	1·4	2·4	4·2	6·4	0·6	1·5	6·6	0·4	15*s.*
Green oats	81·0	1·4	2·3	6·5	8·3	0·5	1·3	8·9	0·2	16*s.*
Green rye	76·0	1·6	3·3	7·9	10·4	0·8	1·9	11·0	0·4	21*s.*
Green rape	87·0	1·6	2·9	4·2	3·7	0·6	2·0	4·8	0·4	16*s.*
Cattle cabbage	84·7	1·6	2·5	2·4	8·1	0·7	1·8	8·2	0·4	18*s.*
Kohl-rabi leaves	85·0	1·8	2·8	1·4	8·2	0·8	2·0	7·6	0·4	18*s.*
Swede turnip tops	88·4	2·3	2·1	1·6	5·2	0·5	1·5	5·1	0·3	13*s.*
„ „ roots	87·0	1·0	1·3	1·1	9·5	0·1	1·3	10·6	0·1	16*s.*
„ „ Lord Walsingham's	88·5	0·5	1·4	1·2	8·2	0·2	...	...	...	16*s.*
Mangold tops	90·5	1·8	1·9	1·3	4·0	0·5	1·2	4·0	0·2	11*s.*
„ roots (German)	88·0	0·8	1·1	0·9	9·1	0·1	1·1	10·0	0·1	15*s.*
„ do. (English, average)	88·0	0·8	1·4	1·1	8·5	0·2	...	...	...	16*s.*
„ do. (do. 18lb. roots)	92·5	1·2	0·4	...	5·9	...	...	...	...	8*s.*
Sugar beet roots	81·5	0·7	1·0	1·3	15·4	0·1	1·0	16·7	0·1	20*s.*
Artichoke tops	80·0	2·7	3·3	3·4	9·8	0·8	2·0	9·4	0·4	20*s.*
„ tubers	80·0	1·0	2·0	1·3	15·5	0·2	2·0	16·8	0·2	25*s.*
Potatoes, tops (October)	78·0	3·0	2·3	6·0	9·7	1·0	1·0	8·3	0·3	14*s.*
„ tubers	75·0	0·9	2·1	1·1	20·7	0·2	2·1	21·8	0·2	30*s.*
Young thistles	86·7	2·0	2·9	1·4	6·1	0·9	2·2	6·0	0·6	19*s.*
Gorse (cut in August)	72·0	2·1	3·2	13·3	8·2	1·2	...	...	...	21*s.*

Kind of Fodder.	Water.	Ash.	Organic Substances.				Digestible Nutrients.			Value per ton.
			Albumenoids.	Crude fibre.	Other Carbo-hydrates.	Fatty matters.	Albumenoids.	Carbo-hydrates, including fibre.	Fatty matters.	
SILOED FODDERS.										
Red clover, German	79·2	2·1	**4·2**	5·9	**6·4**	**2·2**	2·8	7·2	1·7	28*s.*
„ American	79·2	...	...	...	...	...	3·1	8·1	1·7	30*s.*
Clover and sainfoin, Mr. Gibson's ...	57·6	4·1	**7·9**	23·3	**7·1**		...	...	...	50*s.*
Clover and grass, Vicomte Chezelles	50·3	5·6	**9·1**	14·3	**18·6**	**2·1**	...	...	...	56*s.*
„ „ Mr. Eckersley's ...	75·0	2·2	**3·1**	5·5	**13·4**	**0·8**	...	...	...	25*s.*
„ „ Mr. Earle's	78·1	2·4	**2·6**	8·0	**7·4**	**1·5**	...	...	...	20*s.*
„ „ Mr. Fry's	75·8	1·9	**2·5**	7·5	**12·3**		...	...	...	21*s.*
„ „ Mr. Scott's	79·1	1·9	**2·2**	6·3	**10·5**		...	...	...	18*s.*
Grass, Lord Walsingham's, No. 1 ...	74·3	2·5	**3·0**	6·5	**13·0**	**0·7**	...	...	...	24*s.*
„ do. No. 2	65·9	2·7	**3·6**	9·2	**17·7**	**0·9**	...	...	...	26*s.*
„ do. No. 3	73·5	3·9	**2·8**	8·1	**10·9**	**0·8**	...	...	...	21*s.*
„ Lord Egerton's, No. 1	68·7	4·9	**3·0**	9·9	**11·1**	**2·3**	...	...	...	25*s.*
„ do. No. 2	65·8	4·5	**3·4**	9·1	**15·4**	**1·8**	...	...	...	26*s.*
„ do. No. 3	78·6	3·2	**2·1**	7·4	**8·0**	**0·9**	...	...	...	18*s.*
„ Mr. Duncan's	78·4	1·8	**2·2**	6·2	**10·3**	**1·1**	...	...	...	20*s.*
„ Mr. Fry's	74·4	2·1	**2·6**	8·7	**12·2**		...	...	...	21*s.*
„ Mr. Grant's	70·4	2·2	**4·1**	9·5	**13·0**	**0·8**	...	...	...	29*s.*
„ Mr. Smith of Wilmslow	81·4	2·6	**2·5**	5·8	**7·0**	**0·7**	...	...	...	18*s.*
Rye Grass, Glasnevin, No. 1	66·5	3·4	**2·8**	11·3	**15·2**	**0·8**	...	...	...	24*s.*
„ do. No. 2	68·1	3·6	**2·6**	10·1	**14·8**	**0·8**	...	...	...	23*s.*
Rye, American (Dr. Voelcker)	75·2	1·5	**1·8**	11·0	**9·6**	**0·9**	...	...	...	17*s.*
„ Mr. Gibson's	72·6	2·1	**2·0**	9·7	**13·6**		...	...	...	19*s.*
Maize, German	83·5	1·1	**1·2**	5·3	**8·0**	**0·9**	0·8	8·6	0·4	14*s.*
„ American (Dr. Voelcker)	82·4	1·1	**1·3**	5·1	**8·5**	**1·6**	...	...	...	16*s.*
„ do. average of eleven analyses	82·0	...	...	...	...	...	1·0	10·2	0·5	17*s.*
„ Lord Walsingham's	86·3	2·3	**1·1**	5·1	**4·8**	**0·4**	...	...	...	11*s.*
„ M. Goffart's (p. 181)	81·3	2·3	**1·2**	4·9	**10·0**	**0·4**	...	...	...	14*s.*
„ Prof. Moser's, 17in. (p. 180)...	57·6	3·7	**1·9**	18·3	**16·6**	**1·9**	...	...	...	24*s.*
„ do. 34in. (do.) ...	77·8	2·2	**1·0**	10·4	**7·5**	**1·1**	...	...	...	14*s.*
„ do. No. 2 (do.)	80·7	2·2	**0·8**	8·4	**6·8**	**1·1**	...	...	...	12*s.*
„ M. Cottu's, 1877	83·0	1·3	**1·2**	4·4	**9·6**	**0·5**	...	...	...	13*s.*
„ do. 1880	77·7	1·8	**1·0**	5·2	**13·9**	**0·4**	...	...	...	14*s.*
Spurrey, Lord Walsingham's	73·5	3·6	**2·4**	8·8	**10·2**	**1·5**	...	...	...	22*s.*
Sainfoin, German	52·5	3·3	**9·8**	15·4	**16·7**	**2·3**	...	...	...	56*s.*
„ (M. Cottu's)	74·5	2·9	**4·6**	6·0	**11·4**	**0·6**	...	...	...	29*s.*
Artichoke leaves (do.)	65·1	4·0	**2·4**	7·3	**20·8**	**0·4**	...	...	...	24*s.*
„ tubers (do.)	78·5	2·6	**1·6**	2·3	**14·8**	**0·2**	...	...	...	21*s.*
Swede turnip roots (fermented)	84·6	2·8	**1·4**	1·7	**10·8**	**0·2**	...	...	...	20*s.*
Sugar beet leaves	80·0	4·1	**3·0**	2·7	**9·0**	**1·2**	2·0	6·3	0·7	18*s.*
Potato tops	77·0	5·3	**2·9**	4·7	**7·5**	**2·6**	1·2	6·2	1·3	16*s.*

The three columns which give the constituents containing the nutritive materials in the provender are printed in more conspicuous type. These nutrients are not of equal money value; the albumenoids and fat being worth about $2\frac{1}{2}d.$ for each pound digested, whereas the carbo-hydrates, including digestible fibre, are worth about one-fifth of that amount, or $\frac{1}{2}d.$ per lb.

Where the figures stand across two columns, the "fatty matters" are not separated from the other carbohydrates in Dr. Voelcker's analyses. In two of the lines with reference

to mangolds, we have included Dr. Cameron's analyses of average-sized and extremely large roots, in order to show that the feeding value varies with roots as well as with silage, and that there is comparatively little nutriment in huge watery specimens, although heavy manuring may produce a greater number of tons per acre.

Results of Feeding Experiments.

A cattle-feeding experiment carried out by Mr. Stobart at Pepper Arden is described by his agent, Mr. Easdale, at page 208, where a table is given showing the weights of the animals before and after the experiment. Twelve beasts received 11lb. each daily of meal and cake, but six of them were allowed 24½lb. of hay and 95lb. of turnips, while the remainder had 75lb. of silage. At the end of three weeks the latter had increased in weight 4¾cwt. and the former 4cwt. 1qr. 7lb., being a difference of 49lb. in favour of the animals fed upon silage; *i. e.*, rather more than 8lb. each for the whole period, or about 6oz. each per day. Some conclusions which Mr. Easdale arrived at were taken exception to by Mr. T. Parry, in the *Farmer's Gazette*, as follows:

Mr. Easdale contends that this experiment proves the superiority of ensilage over the quantities of hay and turnips specified above, leaving "a considerable something to spare besides." Very well, let ns examine the facts.

In Lot A, 1332lb. of live weight increased, on an average in 21 days, 88·6lb., while in Lot B 1082lb. of live weight, on an average in 21 days, made an increase of 80·5lb. in live weight. If we reduce these different increments into a "common denomination," we shall find the relative increase in each case. In Lot A every 100lb. live weight increased 6·6lb. in 21 days, while every 100lb. live weight in Lot B increased 7·5lb. in the same period—showing a difference of 12 per cent. in favour of hay and turnips. Mr. Easdale's contention, therefore, hopelessly falls to the ground.

I would also point out that the omission of various details, such as the proportions and kinds of cake and meal given to the beast, the kinds of hay, the ages of the stock, and their recent history—these, combined with the rather serious difference in the total weights of each lot, are calculated to vitiate the accuracy of the experiment, and in this particular case as a test of the nutritive value of ensilage.

We agree with Mr. Parry that the omission of various details, and the differences in the weights of the animals, have a tendency to vitiate the accuracy of the experiment. But the result is not quite so bad as appears from his letter; for, by some accident, he has put the average weight of Lot A as 100lb. more than it should be, and that of Lot B as 19lb. too little; seeing that 66cwt., or 7392lb., give 1232lb. as the average of the six animals in the former lot, and 59cwt., or 6608lb. give the average of the latter as 1101lb. If these errors be rectified, Lot B, when the increase is calculated on every 100lb. of live weight, still have an advantage, but, instead of its being 12 per cent. in favour of hay and turnips, it is only 2 per cent. (It may be well here to point out, in order to prevent confusion, that Lot A of Mr. Parry's letter is the second lot in the table as printed in Mr. Easdale's letter on page 208, where Lot B is placed first.)

Agreeing, as we do, with Mr. Parry, that the increment in animals of different weight ought to be reduced to a common basis of comparison, we should not have reproduced his remarks merely for the purpose of pointing out an inaccuracy in the figures. We wish, however, to show that, in order to form a reliable estimate of the improvement of animals that vary in size, it is necessary, not only to take into consideration the relative increase on original live weight at the beginning of the experiment, but also to *allowance the food* in proportion to that weight. Such, however, was not done in the experiment now under consideration. The animals in Lot B received the same quantities of meal and cake as the heavier beasts in Lot A; and, with respect to the rest of the dietary, the smaller beasts had much the greater amount of food. This may not be obvious at first sight; but if we examine the quantities more closely we shall find such to be the case.

Lot B received 24½lb. of hay, which, at the average amount of moisture in hay (15 per cent.) would consist of about 3½lb. of water and 21lb. of dry material. They also received 95lb. of turnips, which, with 88 per cent. of moisture, would contain about 84lb. of water, and 11lb. of dry matter. Accordingly,

each of the animals in Lot B received 32lb. of dry feeding material per diem, besides the meal and cake.

Lot A received 75lb. of silage; and by Mr. Jenkins's report it appears that a sample of Mr. Stobart's silage contained 76 per cent. of water. At this rate 75lb. of silage would consist of 57lb. of water and 18lb. of dry matter. Consequently there would be 3lb. less dry feeding material in the 75lb. of silage than in the 24½lb. of hay alone, and 14lb. less than in the hay and turnips together.

If these two lots of animals had been fed in proportion to their weight, Lot B would have had more than one-tenth of their supply of meal and cake cut off; and their allowance of hay and turnips would have been reduced one half, seeing that they were receiving in this form 32lb. of dry feeding matter, whereas their proper proportion was only 16lb. On the other hand, if 32lb. was not too much for Lot B, then 36lb. was the proportionate quantity for Lot A, and they were entitled to double the amount of silage they received, or to an equivalent in some other supplementary food. Indeed, if anything, the quantity should be greater, as, weight for weight, the *dry* constituents of swedes stand higher in feeding value than those of grass or hay; and it is with respect to the dry constituents of the food that the above remarks are made.

Taking these circumstances into consideration, there seems little ground for surprise that Lot A did not make greater progress in comparison with their live weight; the surprising matter is that they increased as they did, and to the extent shown in the following table:

	Average Weight on Nov. 17.	Average Weight on Dec. 8.	Increase in 21 days.	Increase per diem.
Lot A	1232lb.	1328lb.	96lb., or 7·19 per cent.	4lb. 4oz.
Lot B	1101lb.	1182lb.	81lb., or 7·34 per cent.	3lb. 14oz.

The percentage of *relative* increase in Lot A is, as previously remarked, a little lower than in Lot B, but the *actual* increase in the silage-fed beasts was highest by 6oz. a day, though receiving much less feeding matter in their rations. The conclusion that we arrive at is, that the effect of the silage

was not confined to its own nutrient qualities, but that there were certain constituents in it which enabled the beasts to digest more thoroughly the 11lb. of cake and meal, and thus to extract more nutriment from the lesser quantity of feeding matter. The benefit derived from food lies, not in the quantity that is eaten, but in the quantity that is digested.

That such an effect as is here indicated is produced by mixing silage with other food is, we think, clearly proved by the evidence of various experiments. From what we have said at page 25, and the estimates given at pp. 155-6, it will be obvious that we consider maize to be of comparatively low feeding value, when regarded as a sole article of diet; nevertheless we cannot overlook the consequences of an admixture of maize silage with other food, as shown by the result of the experiment carried on with Lord Walsingham's cows, and detailed by Mr. Woods in his South Kensington lecture. We have, on the one hand, the figures of Mr. Sutton's analyses, stating the constituents of the maize before and after ensilage; and, on the other, we have Mr. Woods' tables showing the quantity of milk and proportion of cream given day by day with the different dietary, and can see the effect produced by the change from one dietary to another. Either we must conclude that these figures are fictitious (which we are not at all disposed to believe), or we must suppose that the maize silage had an influence over and above the amount of nutriment inherent to itself, and that that influence was shown in its turning other portions of the rations to more profitable account.

At the time of entering upon the trial two cows were receiving a daily allowance of 6lb. maize meal, 8lb. bran, and 30lb. chaff (mixed hay and straw). The weight of the respective animals and their daily produce of milk and proportion of cream were as follows:

	Weight.	Milk Average.	Cream.
Lady Manchester ...	48st.	11½ quarts	11°
Spark 4th ...	56st.	11 ,,	11°

On Jan. 10 the dietary was altered, and both animals

received 8lb. maize meal, 2lb. bran, and 10lb. chaff (straw), in addition to which Lady Manchester had 42lb. of maize silage, while Spark 4th had 70lb. of Swedes.

Lady Manchester continued to receive her dietary of silage, &c., for twenty-eight days. Spark 4th received the swedes for twenty-two days, and for the other six days she had exactly the same food as Lady Manchester, the silage being substituted for swedes. The average produce of milk and cream of the two animals, and their respective weights at the end of the four weeks, were as follows :

	Weight.	Milk Average.	Cream.
Lady Manchester (28 days)	52st.	$14\frac{1}{4}$ quarts	$13\frac{3}{4}$°
Spark 4th (22 days)	—	$12\frac{1}{4}$ „	$12\frac{1}{2}$°
Ditto (6 days)	58st.	$15\frac{1}{4}$ „	13°

By comparing this and the last table it is seen that at the end of the time Lady Manchester weighed 4st., or 56lb., more than at the beginning, having increased 2lb. a day on the average. With Spark 4th the increment was only half as great, as she was 28lb. heavier at the end of the month, and thus had increased 1lb. a day on the average; but how much of that increase occurred while she was on turnips, and how much on silage, does not appear on the record.

With regard to the milk supply, however, the information is more explicit. Lady Manchester gave $2\frac{1}{2}$ quarts more milk a day on the average of the month, and the cream rose from 11° to 14°. Spark 4th gave an increase of $1\frac{1}{4}$ quarts a day on the average during the time she had the swedes, the cream rising from 11° to $12\frac{1}{2}$°; but during the six days in which the swedes were changed for silage there was a further increase of 3 to $3\frac{1}{2}$ quarts a day, while the cream rose to 13°; so that, whereas she had always been lowest in quantity of milk previously, she "came with a bound" on receiving the silage, and surpassed her rival by 3 pints a day, although she did not attain the same level as regards proportion of cream.

Evidently, therefore, there must have been something in the silage to produce so marked a difference of result; and the question is, what is that something? So far as regards

the mere quantity of nutriment in the two kinds of provender, Mr. Sutton's analyses show that the advantage was greatly in favour of the swedes. Instead of taking mere percentages, let us change the figures so as to represent the actual quantities given to the animals in their daily rations, viz., 42lb. of maize silage and 70lb. of swedes respectively; then the proportions of water and other constituents stand as follows:

	Maize Silage.	Swedes.
Albumenoids (flesh formers)	0·48lb.	0·97lb.
Carbo-hydrates (sugar, gum, &c.)	1·77	5·71
Fatty matters	0·18	0·15
Woody fibre	2·13	0·86
Ash	0·97	0·37
Acetic and lactic acids	0·23	0·00
	5·76	8·06
Water	36·24	61·94
Total	42lb.	70lb.

We here find that the chemical constituents in the first three lines—on which the nutritive value of the provender is estimated—are very much higher in the allowance of swedes than in the allowance of silage. The albumenoids in the swedes are twice as high as in the silage, the carbo-hydrates more than three times as great, and the fatty matters nearly equal; while the indigestible woody fibre and ash are exceedingly abundant in the silage, forming more than one half of its entire solid matter.

If, however, there is so much less nutriment in the silage than in the turnips, it may be asked, What is it that causes such an improvement in results?

On looking over the constituents of the silage, it will be seen that there is a certain item which has no corresponding quantity in the swedes. There is 0·23lb., or nearly 4oz., of acetic and lactic acid in the one, and none whatever in the other. Excluding the water in the silage, nearly one-twentieth of its whole weight consists of the acids; and here we may probably find a clue to the mystery. Lactic acid is a very powerful solvent of food; and its effect would

not be limited to the silage in which it is formed, but it would likewise assist in the digestion of other portions of the provender given to the animals. In the 42lb. of silage there was, as shown in the table, less than 6lb. of solid matter; but this was supplemented by 8lb. of maize meal, 2lb. of bran, and 10lb. of straw chaff, or 20lb. altogether; so that the silage formed only about one-fourth of the entire quantity of solid food contained in the daily dietary. The whole of this additional 20lb. would not be utilised under ordinary circumstances; for, as will be seen by reference to the particulars given by Mr. Woodland Toms on page 173, a very large proportion of some of the most nutritious constituents of the food will generally pass through the animal undigested. If, then, the solvent action of the acids contained in the silage enables a larger portion of the meal, bran, and straw to be digested, the animal that receives the silage may obtain a much larger amount of nutriment from its daily dietary, although the whole of that additional nutriment may not be directly derived from the silage itself.

Another ground for believing that the advantageous effects produced by the silage are not due merely to its own nutrient qualities, is to be found in the fact that, in various instances, when the quantity of silage has been increased beyond certain limits, the animals have fallen off in condition, although the amount of meal or hay withdrawn was apparently not disproportionate to the extra quantity of silage given. One may readily understand that a limited amount of some condiment may serve as an aid to digestion, yet that, by unduly increasing the condiment and reducing the other articles of diet, deterioration would ensue, instead of improvement.

It is very probable that some of the conflicting accounts of results of feeding experiments with silage may be due to the different quantities of acids produced in the fodder; for the greater the acidity in the product, the less would it be fitted to become a sole article of diet. Maize is likely to produce a much greater amount of acid than many other crops; and as

maize silage is given as an exclusive article of diet by some American farmers, it is not surprising that bad results are reported from time to time; for an animal may thrive on 20lb. of acid silage mixed with meal, &c., but may do very badly on 100lb. of the same silage and no meal. Further investigation is required to trace the effect of different methods of ensilage in producing the various acids, lactic, acetic, and butyric, as well as their influence on the digestion of the animals; but where very large quantities of silage are given daily with satisfactory results it seems probable that the proportion of acid is comparatively small.

An experiment in fattening cattle which is rather remarkable for the very large quantity of silage that was given to the animals was carried out by M. Nivière, whose experiment in the slow filling of his silo is narrated at page 116. He gave in the *Journal d'Agriculture Pratique* of March 22, 1883, an account of the feeding of two bullocks, of the Charolais breed, on some Trifolium incarnatum which he had siloed. The daily rations per head were regulated as follows:

	Trifolium silage.	Cotton cake.
Dec. 1 to 15	60 kilos (132lb.)	0
Dec. 15 to Jan. 15	50 kilos (110lb.)	3 kilos (6½lb.)
Jan. 15 to March 6	40 kilos (88lb.)	4½ kilos (10lb.)

M. Nivière states that the cake was first soaked in water, and given at each meal in the form of a soft paste. One animal he sold on Feb. 20, and the other on March 16. The live weight of the two beasts at the commencement of the experiment was 1403 kilos (3091lb.); the fattening was carried on for 81 days with one and for 95 days with the other, making a total of 176, or an average of 88 days each; and the daily increase was 1034 grammes, or 2lb. 4½oz. each.

In the same journal, on May 15, 1884, M. Nivière gives the result of his feeding experiments with the crop siloed in June, 1883, which consisted of mixed grasses (described on p. 116), cut in full flower. Besides affording provender for working bullocks, milch cows, &c., this silage formed the basis of

nutrition of fourteen fatting beasts. The average weight of these animals was 555 kilos (1224lb.); they cost 70f. the quintal (3*d.* per lb. or 3*s.* 6*d.* per stone) live weight, and were sold at 78f. (3*s.* 10½*d.* per stone) weighed and delivered on the farm. Their rations were 7lb. of silage for every 100lb. of live weight, besides 3¼ kilos (7lb. 2oz.) of cotton cake per head, and nothing more. The mean duration of the time of fattening was 61 days, and the increment per head per day was 1047 grammes (2lb. 5oz.)

At pp. 276-280 we have given particulars of the ensilage experiments carried out by Mr. Edwards at the St. Alban's Dairy Farm. It is stated at the end that feeding experiments were to be carried out under the superintendence of Sir John Lawes, but at the time those pages were printed the results had not been make known. Since then (in the *Live Stock Journal* of May 9, 1884) a most elaborate series of tables has been published; and these we propose now to summarise.

Three lots of cows, seven in each lot, were selected, and fed before the commencement of the experiment on 4lb. cotton cake, 4lb. maize meal, 2lb. bran, 10lb. oat straw, 21lb. grains, and 24lb. cabbage. Omitting minute fractions, the dietary and produce during two months' trial were as follows:

LOT 1.—Comparative food: 18lb. chaff and 45lb. mangold per head per day.

Week ending	Cotton Cake.	Maize Meal.	Bran.	Chaff.	Man-gold.	Total Food.	Milk per day.
	lb.	lb.	lb.	lb.	lb.	lb.	lb. oz.
Dec. 11, 1883	4	4	2	19½	15½	45	17 9
" 18, "	4	4	2	20	43	73	17 2
" 25, "	4	4	2	18	45	73	18 9
Jan. 1, 1884	4	4	2	18	45	73	17 7
" 8, "	3½	3½	2	18	45	72	16 4
" 15, "	3	3	2	18	45	71	15 12
" 22, "	3	3	2	18	45	71	15 12
" 29, "	3	3	2	18	45	71	15 9
Feb. 5, "	3	3	2	18	45	71	18 13
" 6 to 9	3	3	2	18	45	71	17 11
Average { Fresh food	3·4	3·4	2·0	18·2	44·7	71·7	17·0
Average { Dry matter	2·9	3·0	1·7	15·2	5·6	28·4	

LOT 2.—Comparative food: 14·4lb. chaff and 60¾lb. mangold per head per day.

Week ending	Cotton Cake.	Maize Meal.	Bran.	Chaff.	Mangold.	Total food.	Milk per day.
	lb.	lb.	lb.	lb.	lb.	lb.	lb. oz.
Dec. 11, 1883	4	4	2	7	36	53	19 6
„ 18, „	4	4	2	15	59	84	18 9
„ 25, „	4	4	2	15½	65	90	18 3
Jan. 1, 1884	4	4	2	14½	62	86½	18 3
„ 8, „	3½	3½	2	14	60	83	19 1
„ 15, „	3	3	2	14	60	82	20 8
„ 22, „	3	3	2	14	60	82	20 13
„ 29, „	3	3	2	14	60	82	20 15
Feb. 5, „	3	3	2	14	60	82	20 8
„ 6 to 9	3	3	2	14	60	82	20 5
Average { Fresh food	3·4	3·4	2·0	14·4	60·7	83·9	19·11
Average { Dry matter	2·9	3·0	1·7	11·9	7·6	27·1	

LOT 3.—Comparative food: 40lb. silage per head per day.

Week ending	Cotton Cake.	Maize Meal.	Bran.	Silage.	Mangold.	Total food.	Milk per day.
	lb.	lb.	lb.	lb.	lb.	lb.	lb. oz.
Dec. 11, 1883	4	4	2	29½	20	59½	17 6
„ 18, „	4	4	2	40	1½	51½	15 14
„ 25, „	4	4	2	40	...	50	19 3
Jan. 1, 1884	4	4	2	40	...	50	18 8
„ 8, „	3½	3½	2	40	...	49	17 7
„ 15, „	3	3	2	40	...	48	16 8
„ 22, „	3	3	2	40	...	48	16 14
„ 29, „	3	3	2	40	...	48	16 10
Feb. 5, „	3	3	2	40	...	48	15 13
„ 6 to 9	3	3	2	40	...	48	15 1
Average { Fresh food	3·4	3·4	2·0	40	0·2	49	16·4
Average { Dry matter	2·9	3·0	1·7	19·4	0·03	27	

Without individualising the animals, they may be briefly described in the following particulars, to which is appended the average yield of milk of each lot on the day before the experiment began:

	Average Milk. lb. oz.
Lot 1.—Seven cows, averaging 24 weeks 3 days since calving	19 3
Lot 2.—Seven cows, averaging 20 weeks 4 days since calving	19 14
Lot 3.—Seven cows, averaging 16 weeks 3 days since calving	18 11

From Dec. 4 to Feb. 9 the three lots were fed alike as to cake, meal, and bran, but varied as to chaff, mangold, and silage. The chaff throughout, except on the first day, consisted of one-third hay to two-thirds oat straw.

The average cost of the food per head per week from Dec. 12 to Feb. 9 is estimated as follows :

	Cotton Cake.	Maize Meal.	Bran.	Chaff.	Mangold.	Silage.	Total.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s d.*	*s. d.*	*s. d.*
Lot 1	1 4	1 9	0 8	2 3	1 4¾	...	7 4¾
Lot 2	1 4	1 9	0 8	1 9½	1 10¾	...	7 5¼
Lot 3	1 4	1 9	0 8	...	...	4 4½	8 1½
Price per ton...........	£6 5*s*.	£8 5*s*.	£5 5*s*.	£2.	10*s*.	£1 15*s*.	

The price per ton, at the foot of the last table, gives the sums on which the previous calculations of cost were based. The cotton cake was undecorticated; the chaff was one-third hay at 3*l*. per ton and two-thirds oat-straw at 30*s*. a ton. The value of the silage was calculated by Sir J. B. Lawes in this way : To the dry matter in the silage was added one-fifth of its weight (to put it on an equality with the hay as regards amount of moisture), and then it was reckoned at the same price as the hay, viz., 3*l*. a ton. Mr. Edwards, being of opinion that the calculations of cost of feeding put the silage at a disadvantage, wrote to Sir John Lawes on the subject, and his letter, and the reply thereto, were as follows :

"Westminster Lodge, St. Albans, 21st April, 1884.

"Dear Sir John,—I am extremely obliged for the very exhaustive and complete calculations you have sent me, relating to the experiment of Silage *v*. Mangolds; but I should like to draw your attention to one point —namely, that of the 'cost per head' of each lot of cows. I find you have taken the cost of hay at 3*l*. per load; that is too low, as I am making 3*l*. 13*s*. 6*d*. of the same class of hay in the rickyard. The mangolds you have taken at 10*s*. per ton; this is also too low, as I bought all the mangold at 17*s*. per ton delivered at the dairy. The value of the silage I think you have placed much too high; I only estimate its value at one-third that of hay. If you were to base your figures on the above, I think you will find that the 'cost per head per week' is about as follows:— Lot 1, 9*s*. 6*d*.; lot 2, 9*s*. 7*d*.; lot 3, 7*s*. 1*d*. My reason for estimating the silage at one-third the value of hay is that I find I had three times

the weight of silage to that of hay per acre. The loss of weight of the grass in the silo was very trifling (if any). I quite agree with you that the bent grass I used was not succulent enough to make first-rate silage; therefore, I think that silage made from more succulent grass or maize will prove a valuable addition to a dairy farm. I shall be glad to hear your views as to the above figures.—Yours truly,

" Sir J. B. Lawes, Bart., Rothamsted." " I. N. EDWARDS.

" Rothamsted, St. Albans, April 22, 1884.

" Dear Sir,—In estimating the value of food, we consider it to be the fairest plan to make some allowance for the manure value. When they are consumed on the farm, the manure value of a load of hay is really worth more than 13*s.* 6*d.* With regard to mangolds, I should estimate the food value at about 10*s.* per ton, manure value 5*s.*, total, 15*s.* If you purchased mangolds regularly, I think that you might have them for 15*s.* per ton. With regard to the value of silage, the calculation was made as follows: 40 × 7 = 280, at 50 per cent. of water = 140lb.; add 20lb. of water, to bring it to hay composition, makes it nearly equal to 1½cwt. hay; so we valued it as hay. It would appear by the various statements that hay-making and ensilage-making cost about the same. You can, of course, make any alterations you please in the figures. I hope, if you make ensilage this year, that you will weigh the grass which goes in carefully.—Yours truly, J. B. LAWES.

I. N. Edwards, Esq."

The difference in the cost per head per week, as estimated by Sir John Lawes and by Mr. Edwards is shown in the following table:

	Sir J. B. Lawes.	Mr. Edwards.
	s. *d.*	*s.* *d.*
Lot 1.—Mangold, &c.	7 4¾	9 6
Lot 2.—Mangold, &c.	7 5¼	9 7
Lot 3.—Silage, &c.	8 1½	7 1

On the question whether, in estimating the cost of the food, a reduction in the price of hay and turnips ought to be made on account of their manurial value, opinions may be allowed to differ; but we think that Sir John Lawes's mode of estimating the value of the silage is a much more reliable one than that of reckoning it as one-third the value of the hay. Indeed, with grass so dry that the silage contained only about 50 per cent. of water, we do not see how it would

be possible to get three times as much silage as hay from the same quantity of herbage. (Remarks on the proportion of hay to silage will be found on page 108.)

Some rather curious results are shown in these feeding experiments. When the cows were taken off grains (probably containing more acid than this dry silage), the milk fell off with all three lots, though not in an equal degree, as will be seen by the following figures :

	Before the Experiment.	During the Experiment.		
		First week.	Second week.	Third week.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Lot 1.	19 3	17 9	17 2	18 9
Lot 2.	19 14	19 6	18 9	18 3
Lot 3.	18 11	17 6	15 14	19 3

In the third week of the experiment, Lot 3 was the only one that had got up to its original quantity. In the fifth week, as will be seen by reference to the previous tables, the amount of cake and meal was reduced, and further reduced in the following week, whereupon Lots 1 and 3 dropped again, the latter especially; but Lot 2, strange to say, although reduced in mangold and chaff as well as cake and meal, gave, for the next five weeks, on the reduced dietary, a larger supply of milk than they had given before.

This series of experiments, unlike the others, does not redound to the credit of the ensilage process; but the silage appears to have been of inferior quality. Not only was the grass too dry to produce the best results, but the form of the silo (shown on page 276) was opposed to a proper settlement of the material it contained. Mr. Jenkins says, in the R.A.S. report: "The cause of so much mould and waste is not far to seek. A glance at the section of the silos will show that they have sloping sides, and therefore the weighted doors could not follow the pitted fodder as sinking progressed. This was made evident as soon as the arrangement was seen, owing to the curious inequalities of surface which the doors presented."

Among the less elaborate experiments in feeding that have been carried out are the following :

In Earl Fortescue's experiments (page 240), nine cows were divided into three classes (A, B, and C) and put respectively on the following dietary, each animal receiving one-third of the quantity stated :

	Class A.	Class B.	Class C.
Decorticated cotton cake	6lb.	6lb.	6lb.
Undecorticated ditto	6	6	6
Oilcake	6	6	6
Pollard	6	6	6
Wheaten straw chaff	**16**	**16**	0
Hay	**36**	0	0
Grass silage	0	**100**	**150**

For the three weeks from Dec. 26 to Jan. 16, Classes A and B were fed as above stated; but at the end of a fortnight the experiment was stopped as regards Class C, for the animals lost condition, and fell off in the quantity and quality of the produce as compared with Class B.

It will be observed that the dietary is alike for all, except in those parts printed in blacker figures. Where 100lb. of silage was substituted for 36lb. of hay, there was a slight increase of both milk and butter; but where another 50lb. of silage was substituted for only 16lb. of wheaten straw chaff, there was a diminution in quantity, and the butter was ill-flavoured. From remarks made in the early part of Lord Ebrington's lecture (page 240), the silage does not appear to have been first-rate; but it would seem probable that it contained acid or other chemical constituents which enabled it to educe from the remainder of the dietary some amount of nutriment over and above that contained by itself, and that this only operated within certain limits, beyond which the effect might be detrimental. Except for some such qualities it would be difficult to account for the fact that, on the one hand 100lb. of silage gave a better effect than 36lb. of hay, and, on the other, that 50lb. of silage gave a worse effect than 16lb. of straw; for we can hardly expect wheat straw to be 12 per cent. more nutritious than hay.

Mr. Fosbery, agent to the Earl of Warwick, gives (page 256) particulars of a feeding experiment with two lots of four cows each, which had been giving as nearly as possible the same results when fed on 40lb. of pulped mangold, 15lb. of hay chaff, and 6lb. of palm-nut cake and bean-flour mixed. During the experiment, Lot 1 were continued on the same food as before, but Lot 2 received 20lb. to 30lb. of silage (according to their appetites) in lieu of the 40lb. of mangold. The results of the three weeks of trial were as follows :

Lot 1.	Weight of Milk. lb.	Percentage of Cream.	Lot 2.	Weight of Milk. lb.	Percentage of Cream.
First week......	$791\frac{1}{2}$	$59\frac{3}{4}$	First week......	975	53
Second ,, ...	$811\frac{1}{2}$	56	Second ,, ...	994	$51\frac{1}{4}$
Third ,, ...	$767\frac{1}{2}$	$56\frac{3}{4}$	Third ,, ...	$1000\frac{1}{2}$	$53\frac{3}{4}$
Average ...	$790\frac{1}{6}$	$57\frac{1}{2}$	Average ...	$989\frac{3}{4}$	$52\frac{2}{3}$

Accordingly, the average daily produce of the cows in Lot 1, that were fed on mangold, was $28\frac{1}{4}$lb. of milk, or about $11\frac{1}{4}$ quarts; that of Lot 2, fed upon silage, was $35\frac{1}{4}$lb. or 14 quarts a day, being an increase of one-fourth. The per-centage of cream, it will be seen, was less in Lot 2; but the total quantity of cream was greater, it being about one-seventh more than that of Lot 1.

Mr Harris (p. 238) gave in a letter in the *Field* the following particulars of the quantity of silage eaten by young cattle in mid-winter: "I ordered six North Devon yearlings to be let out for about four or five hours every day in a field with other cattle, where there was nothing beyond the ordinary winter bite of grass. They had two feeds in the morning, and two more in the evening. The ensilage was carefully weighed out every day (180lb. for the six yearlings), and each day they failed to eat the whole; the remainder was each day set aside. At the end of the seventh day there remained 100lb. weight of ensilage. The result proves that each yearling ate something less than 28lb. a day. They were looking very well at the end of the week, and seemed quite satisfied with their daily rations, which will be continued in the same way as long as my ensilage lasts."

Mr Johnson says (p. 215), "For the last two months I have been feeding sixteen bullocks and heifers on nothing but ensilage and 6lb. daily of cake and meal; and the result is, I consider, at least a dead heat between them and similar bullocks on the same allowance of cake and meal, and turnips and hay *ad lib.*"

Mr G. Broderick says (p. 219), "I have been feeding milk cows entirely on ensilage, and others of similar age and size entirely on hay, and I find that those on hay eat on an average 28lb. per day each, and those on ensilage eat 66lb. per day, and thrive better than those on hay." Mr Broderick calculates that the 28lb. of hay represents 112lb. of grass, and the 66lb. of silage not more than 70lb. of grass, and concludes that there is a gain of over 30 per cent.

The Rev. C. H. Ford says (p. 225) that "Ensilage has not increased the quantity of milk as he expected," but that "if you calculate the cost of ensilage, it will show a favourable comparison with any other food whatever."

Mr Hunting's experiment (p. 303) at first appeared likely to have a disastrous result; for the cows that received 28lb. a day of silage became seriously constipated in their bowels, and the milk supply fell off one half. The quantity of silage was then reduced to 14lb., and 14lb. of pulped turnips added, whereupon the ordinary yield of milk was brought back, without being either richer or poorer. The silage given in this case appears to have been some which was pitted in a wretched condition, having been originally intended for stacking, but, owing to bad weather, it lay on the ground and was soaked by rain for several weeks, and eventually was put into the silo. The washed-out condition of this fodder will probably account for the unsatisfactory result.

In Lord Londesborough's experiment, four cows were fed on a mixed diet (stated on page 307), and produced an average of nearly 27½lb. or about 11 quarts of milk a day. On 28lb. of silage being substituted for 18lb. of hay and 3lb. chopped straw, the milk slightly increased (about ½lb. or nearly half a pint a day). Then the mangold was knocked off,

and more silage given with 5lb. maize meal, and the milk increased to 29lb. a day, or about 11½ quarts; so that the improvement was not very considerable.

The Marquis of Bute having had a silo made on his home farm, supplied three of his tenants with silage (grass and clover) for the purpose of experiments in the feeding of their dairy cows. The details are given at page 324, but the results may be summarised here. Two cows belonging to one of the tenants were fed for a fortnight on the first of the two kinds of dietary stated below, and during the next fortnight 40lb. of silage was substituted for all the turnips, and a portion of the hay and chaff, oilcake and beanmeal, the result in the daily average of milk and weekly supply of butter being as follows:

Dietary.					Produce.	
Hay and chaff.	Turnips.	Oilcake.	Beanmeal.	Silage.	Milk.	Butter.
56lb.	75lb.	8lb.	9lb.	0	2½ gals.	6lb.
14lb.	0	6lb.	8lb.	40lb.	3 gals.	7lb.
		Increase			20 p. cent.	17 p. cent.

Two cows belonging to a second tenant had, during their second fortnight 24lb. of the same silage substituted for 10lb. of hay, the rest of the dietary remaining as before. The quantity of milk produced is not specified, it being merely stated that there was an increase of three pints per cow when fed on silage; but it appears that the increase of butter amounted to about 17 per cent.

The third tenant substituted 90lb. of silage for 34lb. of hay and 94lb. of turnips, with the result of an increase of milk in the first week, and a falling off in the second. The quantities are not given; but the falling off is said to be due to the silage not having kept perfectly—which is not very surprising, seeing that a fortnight's supply had been taken out of the silo at one time.

In the case of the experiment of Mr. Duncan of Benmore (p. 330), about 120 head of cattle are said to have been feeding on the pitted fodder—the Ayrshire cows getting 45lb. corn (oat) silage, 34lb. turnips, 5lb. of draff (grains), and 6lb.

of straw or chaff, with the result that there was an increase in the yield of milk (quantity not stated); while those not giving milk were getting too fat, and the silage had to be reduced accordingly. Both butter and milk are here said to be delicious.

Sir John F. Dillon says (p. 340) that he fed twenty-five heifers on silage, with 8lb. of cake and 2lb. of hay per diem, and sold them out fat at the end of about nine weeks. One animal was fatted on nothing but silage and 2lb. of hay daily.

Capt. McBride, in an account of his experiments, laid before the County Cork Agricultural Society (p. 344), concludes that 20lb. of silage is equal to 50lb. of roots and cabbage, 2lb. of straw, and 10lb. of hay.

Silage for Horses, Sheep, &c.

In America, cases of sickness and death in horses are alleged to have resulted from feeding on silage. On the other hand many persons state that they have fed their horses on silage with beneficial results. Considering the difference in the product, it is not surprising that there should be conflicting reports. The silage used in America is chiefly made from maize, and there apparently are greater differences of quality in it than in silage made from ordinary grass. M. Goffart says: "I can only repeat what I have said a hundred times, that badly siloed maize nourishes the animals badly, and may even become a poison for them." The brown silage described by Mr. Fry appears to be much more acceptable to horses than that which is sour; and it would seem that horses are much less fitted than cows to consume very acid food.

Sheep have done very well on ensilage in several instances, one of which is described by Mr. Woods at page 267. Pigs are also reported to have thriven on it. And an American correspondent stated that he had found silage of chopped grass very beneficial to poultry.

CHAPTER XI.—EFFECT OF SILAGE ON BUTTER, &c.

A GOOD deal has been said about the effect of silage on the quality of milk and butter. As far as our own experience has gone, the quality of the samples we have tasted has been excellent, the butter made in mid-winter having a richness of colour and sweetness of flavour that usually are to be found only in the produce of the summer months. And the great majority of reports we have seen are to a similar effect. Nevertheless, it is beyond question that there have been many complaints of tainted milk and butter, more especially in America, where the silage is usually of maize, and liable to become extremely alcoholic and acid if carelessly made. Goffart says: "Let a farmer show me the butter which his silage gives during the winter, and I shall need no other evidence to decide on his ability as a siloer."

Sir John Lawes, in the *Agricultural Gazette*, quoted some statements from America (*see* page 353) to show that the quality of the butter was inferior, and Mr. H. Woods, in reply, gave particulars from eighteen British experimentalists as to the results of their experience. Most of them spoke of an improvement in quality, or said the butter was excellent, or never better, or that there was no deterioration, while only one said "I am not pleased with the butter, as it is always pale in colour." In this case the cows received four parts of barley-straw chaff to one part of silage, so they could not have been overdone with the latter.

But, although complaints have been rife in America, the great majority of the evidence seems to be favourable, and the bad results, when details are given, are frequently seen to be the result of bad practice.

In the official report of the United States Department of Agriculture are about ninety returns from owners of silos, nearly all of whom report favourably as to the influence of silage on dairy produce. About half a dozen content themselves with saying "No bad effects;" "Milk sells well; no fault found with it." But the majority are more explicit, as will be seen by a few examples here given:

Improves colour of butter, increases quantity and richness of milk, *where ensilage is good.*

Richer and much pleasanter to the taste; more like that produced from pasture.

The effect on butter was as marked as in the yield of milk, making full as much from the same amount of milk, and being nearly as high coloured as summer butter. We have regular customers for our butter; all said it was the best butter we ever made in the winter, and nearly as good as the best of June butter.

Good ensilage produces more and better milk and cream, *if fed in connection with a proper albumenoid ration,* than I have ever been able to get from any other food. No better butter can be made with any feed I know of, except sweet young grass.

The only adverse reports are as follows, and we append statements as to the character of the silage:

People have complained a little of the taste of the milk and butter; I do not think it injures either. [The silage was "slightly acid."]

Cream did not make so much butter, nor were the colour and flavour equal. [The odour from the silo was "like a whisky still."]

I think, when past a certain stage of fermentation, the ensilage, although relished by the cows, has a tendency to flavour milk and butter like cabbage.

When milch cows were fed without mixing with other foods, there is a tendency to dry them up. When mixed with meal, they gained slightly. [The silage was "sour, apparently a vinegary acid."]

One cause of taint is mentioned in the "Royal Agricultural Society's Journal" by Mr. J. Swan, who says: "If, through want of care, the milk during milking time or afterwards should be left under the influence of the smell (of the silo, it will, of course, become impregnated with that, as it would with any other pungent odour. Since I have given strict orders on this point, there has never been the slightest flavour in milk or butter."

CHAPTER XII.—COST OF HAYMAKING V. ENSILAGE.

It is difficult to make any general statement with respect to the cost of pitting green fodder as compared with that of converting it into hay, because the cartage and other circumstances vary considerably in different cases.

As regards the cost, when the grass is unchaffed, Mr. Grant says (p. 231), "I cut and carried in 1881 five acres at 7*s.* 2*d.* per acre. In such a season, haymaking a like crop would have cost 1*l.* per acre." Mr. G. Broderick says (p. 219), "The cost of storing green crops may be anywhere between 10*s.* and 20*s.* an acre, according to crop and circumstances; but, on the whole, I am inclined to think it is cheaper than making hay." Mr. Oakeley (p. 313) had 54 tons cut, carted, and siloed for 4*l.* 8*s.* 3*d.*, or 1*s.* 7¾*d.* per ton.

As to the cost when the fodder is chopped, there are some rather wide differences. A detailed account (p. 252) of the expenditure at Tatton Park shows it to have been at the rate of nearly 2*l.* 12*s.* an acre. In another elaborate account (p. 277), Mr. Edwards states the cost of haymaking as 1*l.* 2*s.* 5¼*d.* per acre, and that of filling the silo 1*l.* 5*s.* 6*d.*, including 8*s.* 6*d.* for interest on cost of building, &c. Mr. Easdale (p. 299) says what would cost 20*s.* in haymaking would cost 24*s.* to cut and chaff the grass and put it in the silo. Mr. Hunting (p. 302) gives the cost of siloing 70 tons of crops as 15*l.* 13*s.* 6*d.*, or 4*s.* 6*d.* per ton. In the R.A.S. Journal, the expense per ton is estimated by Mr. Garrett Taylor at 9*s.* or 10*s.*; Mr. Hoare, about 7*s.*; Mr. Swan, 5*s.* 6*d.*; Mr. Ashforth, 5*s.*; Mr. Fryer, 4*s.* 9*d.*; Mr. Gibson, 4*s.* 7*d.*; the Duke of Sutherland, 4*s.* 3*d.*; and Mr. C. G. Johnson, 2*s.* 9½*d.* per ton.

THE CHEMISTRY OF ENSILAGE.*

By F. WOODLAND TOMS, F.I.C., F.C.S.

I.—Practice and Theory.

History acquaints us with the fact that, in times of famine, contagious diseases spring up readily and spread with unusual rapidity; and if we be now, as scoffers suggest, suffering from "ensilage fever," our susceptibility to its attack may fairly be traced to the unhealthy and impoverished state that has been brought about by repeated failures of the food-getting processes upon which we have hitherto relied. There can be little doubt, I think, that the majority of the experiments made, or about to be made, in this country with respect to ensilage, have had their origin in a painful experience of the shortcomings of the ordinary process of haymaking, rather than in any prior conviction of the innate merits of the silo. And to persons who are thus influenced there undoubtedly has come a very apposite warning in the cautions of those respected authorities, Sir J. B. Lawes and Dr. Voelcker.

What we need is not merely a change, but an improvement—a relief from ever-impending mischief; and now, in the lull between the tentative experiments of the past and the more active operations that are promised, it is fitting to sum up and review what we have learnt. It seems to me that some such summing-up is especially desirable, because, from a want of a standard of comparison, some persons have styled their experiments "a success," whereas their products, when passed through my hands, have proved distinctly inferior to others which have been described in no more glowing terms. Moreover, there have been statements made public which I either know to be wrong from my own observations,

* These articles formed part of a series which appeared in the *Field*, under the title of "Facts about Fodder." Others have treated on the chemical effects and deterioration produced by rain during hay-making, by fermentation in the stack, &c. The whole are about to be republished in book form.

or which would seem to be so from the teachings of authorities of experience abroad.

Our knowledge on this subject is admittedly imperfect as yet, but it is stronger in some directions than in others. To prevent experimenters wasting time on points already thoroughly thrashed out, and to lay bare the points where information is most needed, I have ventured to frame a few leading questions that appear to me to cover the ground that the agriculturist is chiefly interested in. To the best of my ability, answers will be supplied to these questions; and on those points where the replies are weak, readers are asked to assume that information is wanted, and will be welcomed if supplied. The four test questions are:

1. Can English fodder plants really be preserved in an edible condition by burying in pits; and for how long?

2. Is the resulting product nutritious and advantageous to the animal?

3. Is the method economical to the farmer?

4. How does it compare with alternative systems, already familiar to us?

No one, I think, who has paid any attention to facts recently brought forward, will deny that, by burying green fodder in pits, it may be maintained in a remarkably good state of preservation for months together. The preservation is never absolute or perpetual; but to obtain the *best* results it is necessary to tightly pack the green fodder into large smooth-walled silos, and to maintain the mass under a continued pressure of 100lb. or more per square foot; and "the most energetic compression is always that which gives the best results" (Goffart's book on "Ensilage," pp. 64, 81, 87).

It is not necessary to add any dry material to the green fodder; and to add more than 10 per cent., even with a plant containing so much water as maize, is absolutely prejudicial. Goffart distinctly states that he has added straw, not to keep the ensilage good, but to render the straw eatable; and he found that, the greater the proportion of straw mixed with the green fodder, the less time would the mixture keep (p. 60). "A moist condition in ensilage," he says, "instead of being a cause of deterioration, is, on the contrary, indispensable to the good preservation of the stored materials. Maize, in its normal condition, contains about 85 per cent. of water; and when, by

the addition of dry straw, "the proportion of moisture in the mass is brought down below 75 per cent., good preservation is greatly compromised, and soon becomes impossible if you go beyond that" (Goffart, p. 61). In the *Journal de l'Agriculture* M. Goffart wrote as follows on this subject: "Last winter I tried four experiments in four different silos; one silo contained pure maize, and in the other three straw was added in different proportions; and the greater the proportion of straw mixed with the maize, the worse was the preservation."

Neither should the crops be allowed to partially dry in the field before being put into the silo. "There is no middle term," says M. Goffart; "the crop must either be thoroughly dried and stacked, or stored with all its moisture, if it is required to be converted into ensilage" (p. 72).

The fodder may be siloed whilst in a damp condition; and crops have been successfully pitted when dripping with water. Among the authorities for this are M. Lecouteux, editor of the *Journal d'Agriculture Pratique*, the Vicomte de Chezelles, M. Goffart, M. Julien, president of Agricultural Society of Romorantin, and various American experts, besides correspondents in *The Field*. The following is an instance given by M. Goffart; "Last October my silos were filled during frightful weather; the rain at times fell in torrents; but the ensilage was perfect nevertheless."

Salt is not necessary for good preservation, though it adds flavour to the mass, and may be added in small quantities—two or three pounds to a ton, so that a cow may get an ounce or so in her daily rations (Goffart, p. 89). In America the use of salt is now abandoned as unnecessary ("Thurber on Ensilage," p. 22), and the excessive amount of salt (2lb. to the hundredweight) used in some experiments in this country has been found by practical men to be hurtful, and has been condemned by veterinarians. As salt did not improve the ensilage when the fodder was pitted in good condition, so also it did not stop its spoiling when the crop was discoloured and damaged from being left till it was old and beaten down (Goffart, p. 101).

A very acid product is not the ideal to be worked up to in making ensilage. In the product that has undergone least change, alcohol and acids are only found in very minute quantities. To obtain the best result, the expulsion of air is necessary, and this

is secured by heavy weighting. When thoroughly well preserved, ensilage is devoid of taste and smell on first being taken out of the pit. The following describes ensilage as it can be made by proper skill, and as it has been made of late years by M. Goffart. Formerly he thought fermentation in the pit was necessary, and for many years he did not obtain very successful results ; and it was the marked difference in smell and taste, under his improved method, that made the opening of this silo so noticeable. "I opened," he says, "in April, 1877, my last elliptical silo, which contained more than one hundred tons of maize, pitted in October, 1876, or more than seven months previous. It presented one very compact mass of greenish-brown tint, and the temperature did not exceed 10° C. (50° Fahr.) There was no appreciable smell, and, on being put into the mouth, the maize was at that time tasteless ; and the absence of smell and taste produced at first a sensation that was almost disagreeable. I had a few hundredweights of the mass taken out for the next meal of my beasts; and scarcely was it exposed to contact with the air, than it underwent a veritable metamorphosis. The brownish colour became sensibly greener, and a commencement of alcoholic fermentation was not long in setting in, without, however, exceeding the limits beyond which such fermentation ought not to go. This silo was not completely emptied until the 10th of August, and the maize kept in good condition until the last day" (Goffart, p. 75).

The above represents what it is desirable to get in this country, and not the intensely acid products that some experimenters have turned out. The "sour fodder" of the Germans and Hungarians, obtained by burying green food in pits with small precautions, is, there is reason to believe, very wasteful, from the fermentation being carried to excess. M. Goffart has "civilised" the primitive "sour fodder" process, and made it worthy of recognition of modern agriculturists by pointing out the advantage of weights (and well-constructed silos to permit the weights to have full effect) in reducing fermentation to a minimum, and thus preserving the food in a condition most approaching its natural state when freshly cut. Its distinctive marks are, that the temperature is kept low, and the proportion of acid and alcohol remain exceedingly small.

The foregoing extracts epitomise the main features of what M. Goffart recommends, and he, be it mentioned, has made more

experiments in this direction than anyone else. He has given to the term "ensilage" a world-wide repute in connection with the storage of green fodder crops; and I think it would be convenient as well as courteous to reserve that term for substances in which his rules are recognised. If any prefer to reject his advice, work in a crude fashion, and revert to "sour fodder," let them call it by that name, and let the merits of their concoctions be discussed apart.

Many specimens of ensilage have come under my notice during the past two years, and I have observed very considerable difference between them. The difference was certainly one of degree, but I believe that degree was sufficiently wide to constitute the difference between a success and a comparative failure, economically speaking, though nearly all were eatable and free from mould. The most successful specimens—*i.e.*, those that most resemble the freshly-cut plant—had been subjected to considerable pressure; the others were faulty in this respect.

It seems generally admitted that, other things being equal, a crop well supplied with sugar is better adapted for ensilage than one less richly furnished. And it is even more certain that, working with the same material, vast differences may exist in quality of ensilage, according to the care expended in expelling and keeping out the atmosphere. By the use of weights M. Goffart has now, he says, no difficulty in preserving for eight months or more crops which previously he was unable to keep many weeks when he sought to hermetically seal the silo by a covering of clay. He says, too, that the waste by heating or fermentation is very greatly reduced.

It has been a matter of surprise to men of science, quite as much as to farmers, that vegetation can, by such simple means as pitting, be preserved to so great an extent from the decay common to dead organised substances. Among the many more or less satisfactory explanations which have been given, that of Professor Lechartier appears to merit most attention, from the suggestiveness of his experiments, and his high position as an authority on fermentation.

By a very long series of researches on fruit, seeds, roots, and leaves, this investigator has shown that, when these substances are detached from the plants that bear them, life is not extinct in the cells of which they are composed; and that, if maintained out

of contact with the air, this life will go on for a considerable period consuming sugar, and giving rise to alcohol and carbonic acid gas. The evolution of gas slackens after a time, and finally ceases altogether. This kind of fermentation is a proof of vitality in the plant, and is distinguished from the fermentation of decay by the fact that none of the germs that favour putrefaction are found when examining the pulp microscopically. When, however, the evolution of gas stops, the cells are really dead, and, being so, are liable to very rapid destruction when in contact with the atmosphere. So long, however, as the air is excluded, and no fermenting germs penetrate to the interior, the fruit remains dormant, and subject to no further change. Thus, Lechartier has kept pears suspended in closed jars for eight or nine months, and shown at the end of that time that they maintained their colour, and tasted merely like mellow fruit; but, on being exposed to the air, they very quickly became "sleepy" and rotten, and the leaves soon acquired the normal appearance of dead leaves.

Lechartier considers that the facts he has proved to hold good with regard to fruit, seeds, and leaves kept out of contact with the oxygen of the air, find their analogy in green fodder placed under pressure in pits. He has made miniature silos with glass bell-jars containing fodder pressed down by a wooden disc weighted with lead, and so arranged that he could, from time to time, extract the gas for analysis; and he has also sealed up fodders in flasks, and compared their composition before and after fermentation.

He shows that the first action that takes place is the complete absorption of the oxygen in the residual air of the pit—which doubtless is the cause of the brief heating observed when a silo is being filled. During the first week or two (a period varying somewhat according to the composition of the crop, atmospheric conditions, and mode of pitting) there occurs a free evolution of carbonic acid gas, which is succeeded by a greatly diminished outflow lasting over several months. So long as this continues, the fodder remains in a state of good preservation; and, with liberal weighting, a very small evolution of gas is capable of resisting the pernicious tendency of the atmosphere to penetrate into the interior.

The rate of disengagement of this gas, and therefore its efficiency as a preservative, may be gathered from the following figures, obtained with Lechartier's miniature silo. It will be evident that

heavy weights are even more requisite at the end of the experiment than at the beginning:

		Hourly per kilogramme.
12th of November—Gas discharged	....	37·7 cubic centimètres.
22nd ,, ,,	....	14·1 ,, ,,
25th ,, ,,	....	5·4 ,, ,,
6th of December ,,	....	5·2 ,, ,,
28th ,, ,,	....	2·7 ,, ,,
From Feb. 21 to March 1 ,,	....	0·25 ,, ,,

On the 1st of March there was no gas; the cells had lost all activity, and mould may therefore be afterwards expected to appear on the surface, and decay begin to prey upon the ensilage.

If I understand Lechartier aright, he contends that, while the vegetable cells are still alive, they will not grow mouldy and decay. That, when severed from the living plant, each constituent cell possesses a certain vitality in itself, or power of doing work; and that it cannot be considered dead till it has expended that power. That, in the presence of air, the cells live and act with considerable energy, and exhaust their powers early. Out of contact with air, however, they live more sluggishly, and take a far longer time to consume the same amount of sugar; indeed, the process becomes so slow that the sugar is not all consumed when the silo is opened. This is proved by the analyses of Barral, Lechartier, and myself, and by the heating and formation of alcohol that takes place on exposure to air. The vital energy being longer in expending itself, the time is postponed when the moulds and other parasites can begin to prey on the dead residue, and set up their characteristic and generally offensive fermentations. The above, though it sounds somewhat theoretical, is not without experimental proof, for Lechartier has found that the vital action, which will go on for months in a properly-weighted silo, does actually cease in a very few days if air be drawn through the ensilage.

Perfect fruit and undamaged leaves, kept out of contact with air, furnish us, one would think, with "ensilage" under theoretically perfect conditions; yet even here some loss of substance and considerable modifications in the constituents of the fruit occur; and loss of substance is in the same way inevitable to ensilage, even when made in the best constructed silo. It is the price one must pay for the vitality that enables the ensilage to resist putrefaction.

How slight this loss may be reduced to we do not know with

precision, for no conclusive experiments have been made contrasting the weight and composition of that put into a silo with the weight and the composition of that which was taken out.

This is to be regretted, for it deprives us of the best way of ascertaining the economic value of the method. We do possess, however, comparative analyses of ensilage made by wasteful methods, and these will be produced in the next article. They teach a useful lesson to those who adopt such methods, and show, on a magnified scale, the changes that go on. The losses that occur are due to fermentation, which may vary very greatly in extent in the same substance according to the way in which it is pitted; and, as the fermentation varies, the loss will naturally vary in a corresponding degree. M. Barral, who is a chemist as well as permanent secretary of the National Agricultural Society of France, mentions that maize ensilage, pitted in three different silos, possessed temperatures respectively of 46°, 16°, and 10° C. (115°, 60°, and 50° Fahr.), and the degree of acidity was respectively equivalent to ·792, ·544, and ·099 per cent. of sulphuric acid. He says, "It is the maize that has been maintained in the silo at the lowest temperature that contains by far the least acid. It is that one which, in my opinion, has been preserved in a state most resembling maize at the time it was cut." Deductions that are true of one specimen of ensilage, made in one kind of silo, are, however, not necessarily true with respect to that which is made in a different way; but at several of the agricultural colleges in this country and in America the professors are working at this subject experimentally, and we may hope shortly to obtain some statistical results.

II.—The Nutritive Value of Ensilage.

English experience of ensilage is relatively small as yet; but, taking into account France, America, and Germany, ample facts exist to warrant the assertion that all English green crops can be preserved in a condition but little removed from their natural state, by storing them in silos under heavy weights.

In England successful results—though not all equal in success—have been obtained with meadow grass, rye grass, clover of different kinds, green oats, green rye, and vetches. In America, Commissioner Loring, of the Government Department of Agriculture, reports (as the results of inquiries circulated among the farmers

of the United States) that, in addition to Indian corn—which is so high in favour from the immense crops it yields per acre—the ensilage system has been tried on rye, oats, clover, sorghum, rowen, Hungarian grass, and field peas. "In fact, almost every crop used for soiling has been stored in silos and taken out in good condition."

In France, a commission appointed by the National Society of Agriculture speak of good results obtained by thus storing vine leaves in wine-growing districts, apple refuse in cider districts, beetroot leaves, sliced beetroot, and beetroot pulp, in sugar-making districts. M. Goffart, besides maize, rye, various kinds of clover and trefoil, has put into his silos, with more or less success, Jerusalem artichokes, beetroot, comfrey, and potatoes. M. Pornay, of Romorantin, has for some years practised the ensilage of lucerne with success, and was awarded a silver medal for an excellent sample that he exhibited at the Bourges Agricultural Show; and M. Julien, the President of the Romorantin Agricultural Society, names (with other crops already alluded to) rape and buckwheat as suitable subjects for the silo. Lastly, in Germany, cabbages, turnips, and leaves of various kinds, besides ordinary fodder crops, are said to have been stored on much the same principle.

The above facts ought to show that we are here dealing with a law of very wide application, and that contemplated experiments will be by no means the risky speculation that some persons believe. In future, therefore, if the general principle be assailed, the onus of proof should surely in fairness fall upon the objectors, and, where facts are adduced, they should be subjected to rigid cross-examination with a view to ascertain whether the results complained of have arisen from a disregard of rules laid down as essential to success, or whether there is any defect in the rules themselves.

An affirmative reply having been given to the question whether English crops can be successfully preserved in silos, we may pass on with awakening confidence to the consideration of the second query to be answered, viz., "Is the resulting product nutritious and beneficial to the animal?"

The nutritious qualities of ensilage, like those of hay, must of course mainly depend on the substance from which it is made. Ensilage from very inferior fodder may possibly be more palatable than the same material made into hay; but one cannot expect it to

be as valuable as ensilage made from a crop of high nutritive quality. The farmer will notice, too, that there will frequently be a considerable difference in odour and appearance between different species of siloed fodder, even when prepared in exactly similar fashion. Judging from experience so far, ensilage from fine rather dry herbage is far more pleasant to smell and to look at than the ensilage from the coarse grasses of low-lying damp localities. Over and above this difference, due to constituents, the value of ensilage is modified by the mode of curing. Fermentation, in a greater or less degree, is inseparable from ensilage; and such fodder, therefore, is characterised by containing small quantities of alcohol, and acetic and other organic acids. It does not appear that in small quantities they do any harm; indeed, they seem to be beneficial rather than otherwise, and they prove so attractive that many animals will renounce green grass, hay, meal, and other good foods, to feed on the ensilage. Some, indeed. regard the silo as a kind of factory for the preparation of cattle condiments. Experimenters of this class should recollect that they run a risk of using up good feeding constituents to produce these "spices," and should therefore endeavour to stifle the change till the silo is opened, when a short exposure will produce all the alteration necessary.

It is not probable that any of our ordinary English fodder crops, even if inefficiently stored, will develope as much acidity as beetroot and starch refuse, or even so much as maize ensilage sometimes produces; and as such food is tolerated by cattle, we need hardly disturb ourselves on the score of acidity in our own specimens. Even if it should prove excessive, it can always be neutralised by a little powdered chalk being mingled with it after taking it out of the silo. Still, the acetic fermentation should be resisted as much as possible, for such fermentation signifies the consumption of material that is more useful than the resulting product; besides which, the latter is the forerunner of an objectionable fermentation called butyric. By this latter acid a very unpleasant odour is given to the mass; and, although cattle can even put up with this in small quantities, yet they recoil from it in the end, and fall off in their feed. M. Goffart met with this objectionable kind of fermentation in some of his earlier experiments. It arose when he attempted to store crops that had been beaten down and become yellow and decayed at the foot. He finally succeeded in rendering

eatable even such crops as these, but he had to double or treble the weights, and the product resembled the "brown hay" of the Germans rather than that kind of ensilage in which M. Goffart delights.

The Americans, who generally seem to have followed Goffart's directions very closely, appear to have been singularly fortunate in their experiences; for Commissioner Loring, of the U.S. Department of Agriculture, sums up the results obtained by nearly one hundred farmers, who have reported to him, in these words: "The condition of stock fed on ensilage, both as to health and gain in weight, has been uniformly favourable." This refers not only to maize ensilage, but also to the many other green crops they have experimented on. Considering that the Americans are themselves only novices, this speaks much for the simplicity of the process, and is an encouraging testimony of what we may ourselves expect.

I have read carefully through these 100 American reports, and have watched for some time past the opinions expressed in American, French, and German periodicals; and, considering the ordinary tendency of mankind to grumble, and the natural liability to fail when trying a new process, I have been fairly astonished at the small amount of complaint from those who have tried the process and can speak from their own personal experience.

It seems to be taken for granted among users of ensilage that the forage is improved, rather than deteriorated, by a slight alcoholic fermentation; and this is what M. Goffart aimed at when he first commenced working. He soon found, however, that, in the silo, the fermentation is apt to overstep the mark and degenerate into acetic and lactic fermentation, which are to be avoided, because they are wasteful, and finally into butyric fermentation and putrefaction, which is, of course, positively objectionable. Consequently, as Goffart found it impossible to hit off the happy mean in the silo, he now strives to stifle fermentation entirely, so long as the fodder remains there. He finds he can readily obtain the desired amount of fermentation by a few hours' free exposure to the air previous to feeding.

To show the views of Goffart on this point, the following extract may be cited: "If it were necessary to sacrifice the fermentation in order to avoid the loss of materials which is undergone in silos, I should prefer to undergo that loss, because I attach the highest value to fermentation, the good effects of which are indisputable;

but, fortunately, the two points can be easily reconciled. The benefits of fermentation are these: Thanks to fermentation, the siloed materials undergo a commencement of decomposition which facilitates the digestion and increases the nutritive or assimilative power. My beasts, especially the milch cows, when they live exclusively on fresh maize during the summer, consume it in very large quantities, and always have the belly greatly developed—which proves that their food has not all the richness desirable, and that they are obliged to make up for the deficiency of quality by excessive consumption. If my beasts eat siloed and fermented maize, the belly decreases, and their ration (which they themselves limit) diminishes in weight, and their general state becomes more satisfactory. Let us, then, not attempt to suppress fermentation, but only to regulate it."

Fermentation always has the result of producing new substances at the expense of existing constituents; and as some of these new substances are gaseous, fermentation always implies a certain loss in weight.

If animals digested and converted to useful purposes the whole of the food they receive into their system, then undoubtedly loss in weight would be an unmixed evil; and if, again, the loss fell on the easily-digested parts, and left the other constituents untouched, then this would make matters even worse. But luckily (and this is a most important matter) we have evidence to prove that such is not the effect of fermentation on well-made ensilage. There the loss which occurs falls most markedly on the substances that possess the smallest feeding value. Owing, as I believe, to the action of the water present, fermentation does not produce precisely the same effect upon ensilage as upon hay. Fermented hay shows an increase of woody fibre over prime hay, whereas fermented ensilage has commonly a much smaller percentage of fibre than the substance from which it is made. Fermentation apparently acts in a very thorough manner upon ensilage; it not only converts sugar into alcohol, and acetic and other acids, but it also converts the starchlike bodies into saccharine substances, and reduces insoluble woody fibre into soluble bodies somewhat allied to starch. Sugar, starch, digestible and indigestible fibre, have chemically all the same percentage composition; but the last is of small feeding value, and is even actively injurious, for it may encase round substances that are in themselves very easy to assimilate, and thus

prevent their being acted on by the digestive powers of the animal.

Commissioner Loring says: "There are indications that some materials have their value enhanced by the fermentation of the silo, while in others there is a loss;" and I think, when we shall have tested this question more thoroughly, that the value will be found to be most enhanced in substances containing a considerable amount of indigestible matter.

The constituents of grain are naturally digested by the animal with very considerable completeness. If, therefore, we attempt to ferment them, we shall find—as Sir J. B. Lawes showed in the case of malted barley—that the slight improvement in digestibility produced is more than overbalanced by the loss in weight. Such results, however, are not on the same footing with coarser foods, as grass for instance; for here a very considerable amount of indigestible and rejected matter exists, and a loss of weight which would be wasteful with grain, might turn out a good investment as regards grass, from the greater scope for improvement that is possible. From the following table it will be seen that, with inferior hay, the animal may not assimilate one half of what is given him. Could we but manage to make one pound of this poor hay go as far as an equivalent weight of young pasture grass, we could apparently submit to any amount of loss short of one-fourth, and still obtain a balance of profit.

Description of Food.	Proportion of each constituent digested by the animal out of 100 parts supplied.				
	Of organic matter as a whole.	Of albumenoids.	Of fat.	Of soluble carbo-hydrates.	Of fibre.
	per cent.	per cent.	per cent.	per cent.	per cent.
Pasture grass	62·1	68·8	13·4	65·8	57·0
Meadow hay (very good)	51·7	64·3	23·5	56·9	42·6
Meadow hay (ordinary)	46·3	58·4	18·8	51·7	37·3
Maize (soaked grain)	90·9	77·6	68·0	93·9	100·0

The above are the results of actual experiments carried out on a horse by Professor von Wolff, the grass used being cut at various times from the same field. It will be seen that the animal never succeeded in digesting the theoretical amount even of the soluble compounds present; and it would appear that the great obstacle that prevented this was the fibre. There was nearly double as much

woody fibre in the oldest hay as was contained in the younger specimen; and it would, of course, be more consolidated and resistant. When the animal was fed on soaked maize—which contains scarce a tenth of the fibre contained in hay—the digestion of the various constituents immediately became very complete indeed. In the same way I believe that if the woody fibre of grasses can be rendered soluble or disintegrated, not only will a larger proportion of it be digested, but other substances previously locked up will be more readily acted on.

An experiment which can only be explained on some such principle as the above, is one by Professor Henry, of the Agricultural Department of the Wisconsin State University, already referred to in the *Field*. Two equal lots of maize (21,000lb.) from the same field were converted, one into hay, the other into ensilage. Two months afterwards two cows were fed on the siloed maize, and two others on the dried fodder which had been under cover ever since it was well cured. At the end of twenty-one days the food of the cows was changed, and those fed on ensilage before were now fed on dried fodder, and *vice versa*. During this test each cow, whether on ensilage or dried fodder, received 1lb. of Indian corn meal, 1lb. of wheat bran, and 1½lb. of oil meal, morning and evening. Each cow had as much ensilage or dried fodder as she could eat up clean. The cows were fed, watered, and milked at the same hour each day, and every means were used to make the test complete and fair. The results in milk, and in butter churned therefrom, were:

	Milk.		Butter.	
	lb.	oz.	lb.	oz.
Ensilage (with meal as stated) produced......	1456	8	59	8½
Dried fodder (with same meal) produced......	1322	15	53	3½
Increase produced from ensilage	133	9	6	5

The test continued forty-two days. At the rate the food was consumed, the thirteen rows of maize cut into fodder would have lasted forty-eight days, while the thirteen rows made into ensilage would have lasted 67½ days. Thus the ensilage increased the produce of milk 10 per cent., and the butter 12 per cent., showing that the butter-making quality of the milk was also enhanced. Lastly, the proportion of maize consumed as ensilage was 29 per cent. less than that eaten as hay.

Another observation, equally difficult to explain away, is contributed by Mr. O. B. Potter, to the American *Cultivator*. A field

of pearl millet had inadvertently been allowed to attain so large and hard a growth that the cows wholly rejected the stalks, and would eat nothing but the leaves when the millet was offered to them green. By way of experiment, one-fourth of the crop was cut and put into a silo, the remainder of the field being cured by drying in shocks in the ordinary way. This last was found so nearly worthless for feeding dry that it was used for litter in the barnyards and for covering ice in an icehouse; whereas that which was preserved in the pit was opened and fed in April. The cows ate it all, leaf and stalk, eagerly, without any loss or waste, and, Mr. Potter says, it was fully equal in value to the same quantity of the best maize fodder preserved in the pits.

The following experiment by Colonel Le Grand B. Cannon, of Burlington, Vermont, U.S., is interesting, because maize ensilage is contrasted with an approximately equal amount, reckoned dry, of ordinary hay and also of hay and roots. I say "approximately," because the actual proportion of ensilage was rather under than over the mark; for average hay contains about 15 per cent. of water, so that 20lb. of hay would have about 17lb. of dry matter, and the average proportion of water in maize ensilage is said to be about 82 or 83 per cent., so that the quantity of dry matter in the ensilage given to these beasts would probably weigh about 15lb. Colonel Cannon says: "I fed ninety three-year-old steers, divided into three lots; cattle and feed weighed monthly. *First Lot.*—Fed 20lb. hay with 3lb. grain daily, run in yard with shelter. *Second Lot.*—Kept in warm stable and stanchions, fed 17½lb. hay, one peck mangolds, and 3lb. grain. *Third Lot.*—Fed 85lb. ensilage, with 3lb. grain. This lot gained ¼lb. a day more than No. 2, and ½lb. more than Lot. 1. The cost was 5 per cent. in favour of ensilage."

The feeding was kept up for five months and a half, and Colonel Cannon adds: "The cattle fed as stated were in better health and condition than others fed on the chopped hay and grain. I consider ensilage profitable, and believe it entirely healthy, taking the place of roots. It is easily digested, as is shown by the uniform temperature of the animals and the condition of the skin and hair."

Details of an extensive series of experiments by Prof. McBryde, of Tennessee University, are given in Dr. Thurber's book on "Silos and Ensilage." Unfortunately, he worked on single animals only,

and he puts the ensilage at a great disadvantage by comparing together 20lb. best hay (about 17lb. dry matter) with 40lb. maize ensilage (about 7lb. dry matter). Considering, too, that green maize is far poorer in albumenoids or flesh-formers than ordinary grass, it is not surprising that the 20lb. of hay frequently showed better results than the 40lb. maize ensilage. It is only when the tables are turned that one has cause for astonishment; and the following are cases in point. These experiments extended over one month; and the last is especially noteworthy as showing that clover ensilage is far better than maize ensilage:

Daily Rations per 1000lb. live weight.	The animal gained per cent.
20lb. hay (taken as a standard)	1·8lb.
10lb. ,, 20lb. oat straw, 6¼lb. Indian corn meal	3·9
10lb. ,, 20lb. ensilage, 6¼lb. ,,	7·2
20lb. oat straw, 20lb. ensilage, 6¼lb. ,,	6·6
20lb. hay, 6¼lb. Indian corn meal	5·7
20lb. ,, 6¼lb. cotton seed meal	5·6
20lb. ,, 6¼lb rice corn meal	7·5
40lb. ensilage, 6¼lb. Indian corn meal	10·2
40lb. ,, 6¼lb. cotton seed meal	10·1
40lb. ,, 6¼lb. rice corn meal	2·8
5lb. hay, 6¼lb. corn meal, 40lb. maize ensilage	6·25
5lb. ,, 6¼lb. ,, 40lb. clover ensilage	9·03

Of the value of ensilage for dairy purposes the evidence is remarkably strong. Commissioner Loring sums up the hundred reports sent to him in the words: "Ensilage has been fed to milch cows more generally than any other class of stock, and no unfavourable results are recorded. There can be no doubt its greatest value will always be found in this connection. There is a marked increase in quantity and improvement in quality of milk and butter after changing from dry feed to ensilage, corresponding with the effect of a similar change to fresh pasture. A few seeming exceptions are noted, which will probably find explanation in defects easily remedied rather than such as are inherent."

In illustration of this good effect on milk production it is not necessary to go so far as America, as a very admirable example has been furnished us at home by Mr. Henry Woods, in his account of the experiment on Lord Walsingham's estate. The experiment was carried out by feeding five cows on a fixed quantity of crushed oats and bran (6lb. of the former and 3lb. of latter), with as much as they could eat of coarse fodder, which consisted first of

chaff (composed of two-thirds barley straw, and one-third hay), and afterwards of the same chaff mixed with gradually increasing quantities of grass ensilage.

As Mr. Woods' table is published at a subsequent page, it will suffice to quote the amount of milk and cream obtained on the last day of each series:

		Milk. Quarts.	Cream. Degrees.
All chaff (of hay and barley straw) yielded per day		68	12
One-third ensilage and two-thirds chaff	,,	70	13
One-half ensilage and one-half chaff	,,	71	15
Two-thirds ensilage and one-third chaff	,,	77	16
Three-fourths ensilage and one-fourth chaff	,,	82	16

This ensilage was made from grass of exceptionally coarse and poor quality, yet as soon as it was given to the cows the flow of milk increased; and there was a continued gradual increase with the augmented proportions of ensilage allowed, till at the end of one month's experiment the result differed from that obtained at the beginning by 14 quarts of milk per day, or an increase of more than 20 per cent. And on two of the cows being deprived of the ensilage for a couple of days, they each gave three quarts of milk less per day. It is even more noteworthy that the quality of the milk was also greatly improved, as shown by the increased amount of cream. This milk from cows fed on ensilage, when compared with that of other animals fed in a similar way, but without the ensilage, showed a percentage of 3·11 of milk fat, as against 2·76; of sugar, casein, and albumen 9·82, as against 9·37; and of ash 0·75, as against 0·70 per cent. In a word, the ensilage-milk was superior in every respect.

The above facts are quoted because they are statistical results obtained by actual analysis, and therefore are of much greater value than any indefinite statement teeming with adjectives. They suggest, too, the kind of experiments that may advantageously be carried out during the extended trial which the system will probably undergo before long in this country.

So far, the evidence speaks well of the tendency of the silo to produce food which is beneficial to the animal; and it indicates that, relatively to other methods of preserving fodder, ensilage turns out food of good quality. This view, as will hereafter be shown, is also supported by an examination of known chemical facts; and, inasmuch as these have their bearing on the cost at which the advantages are obtained, they will help us to work out

replies to the questions which will confront us: "Is the process economical, all things considered?" and "How does it compare with other methods already familiar to us?"

III.—The Loss by Fermentation.

The main conditions for successfully making ensilage are, as we have seen, simple and few. Nevertheless a feeling is abroad that if it be already so simple, it might be made simpler still; and many who, a few months ago, would deny the possibility of preserving crops in the green condition in any way whatever, are now developing a tendency to complain of the labour of putting on weights, or of the necessity of making a receptacle at all. The number who think thus are, it is to be devoutly hoped, small, for they are dangerous disciples.

Ensilage, let us never forget, though new to us, is very old in itself, and there is little which we are likely to devise during our noviciate that has not been tried before; so that it is scarcely too much to say that what is not recommended may reasonably be presumed to have failed. At any rate, it will be far wiser to fully avail ourselves of the experience of workers on this process abroad, and to turn neither to the right nor the left in the conditions so simple yet so important that they lay down, than it will be to venture on unknown paths in search of improvements. First let us endeavour to do as well as our teachers are doing; improvements may be attempted afterwards.

To make good ensilage, it is necessary, not only to prevent air getting in, but to drive out all air that is already inclosed in the mass. The only practicable way of doing this on the large scale is energetic compression. The early experimenters started without weights, but, finding their importance, have little by little increased them; so that, if we begin with small weights, we shall be simply retrograding, not advancing. In the same way they began with holes in the earth, and now prefer well-built silos. Silos of masonry or wood are useful, because they facilitate the practical working of the process. They are easier to fill and to empty, are cleaner and more permanent, and in short, more convenient. They can also be made watertight, which doubtless is an advantage; but, best of all, they have smooth and regular sides, so that the mass slips down the walls without much friction, and thus the mass becomes com-

pressed with little effort. So far as the preservation of the food is concerned, large and smooth-walled silos are, to my mind, mainly useful as economisers of weight. One can make, it appears, as good ensilage in an earthen pit as in the most expensive silo; but far greater weights must be used to produce the result, for the mass clings to the irregular sides with obstinacy, and is difficult to compress. It is, under any circumstances, necessary to put the heaviest weights round the edge of the silo; the centre will almost take care of itself.

Ensilage has been made, I am well aware, without any artificial weights being placed on the top: but this does not rebut the advisability of having recourse to weights—for in such cases the whole contents of the pit are not well preserved, but only the lower parts that are compressed by the mass above. The upper part and sides, which are not compressed, are generally mouldy and of little value; while even the preserved parts show, by their high acidity, that they would have been much improved if weights had been used. On the score of preservation, deep silos are obviously more to be recommended than shallow ones, and, owing to the smaller surface, less weight is necessary on the whole mass.

For the process to be economical, we must save the top and sides as well as the kernel; and it is to preserve these outer parts that weights are required. Goffart now manages, it is said, to keep the top and sides of his silos almost entirely free from mould, whereas formerly the loss used to amount to 15 per cent. or more.

Mouldiness is a form of waste that every farmer can understand; but there is another variety of waste which also exists, but which it is most difficult to make apparent, because it is not obvious to the eye. It does not occur to him that solid matter can "evaporate" and pass off into the air, even from those portions which he considers to be of good quality. If freshly cut plants containing one ton of solid matter be buried in a pit, under no circumstances is it possible that a ton would be taken out; but the more perfectly the air is excluded, the nearer to a ton the mass will weigh.

An experiment conducted by Professor Moser, of the Agricultural Experimental Station at Vienna, illustrates this fact in a very forcible way. He buried bundles of maize No. 1, of known weight (6000 grammes) at depths of 17in. and 34in., in the centre of the contents of a "grube" or earthen silo familiar to that country, also another lot of maize No. 2, and when the siloes were opened he

re-weighed these bundles and ascertained the loss of each constituent of the fodder. The following give the absolute weight in grammes obtained from each bundle:

	Fresh Maize No. 1.	Ensilage 17in. deep.	Ensilage 34in. deep.	Fresh Maize No. 2.	Ensilage No. 2.
Water	4761	1215·5	2846	4603·2	3886·4
	—	—	—	—	—
Albumenoids	54·0	39·0	36·5	58·8	38·6
Fat	45·6	39·6	39·0	55·2	53·5
Soluble carbo-hydrates	649·2	350·4	273·5	734·4	326·8
Fibre	400·2	386·5	379·0	462·0	404·0
Ash	37·8	40·0	37·0	38·4	39·5
Sand	52·2	39·0	44·0	48·0	70·3
Total solid matter, dry	1239·0	894·5	809·0	1396·8	932·7

In Hungary the method for preparing "sour fodder," as they call it, is to dig a long trench in the ground, and fill in the fodder, not only up to the level, but far above it, and then to cover the whole over with earth. There is a constant tendency, under these circumstances, for the earth to crack round the sides, and air gets in accordingly. Considering, too, that the French and Americans, with their more perfect silos and heavier compression, still consider it necessary to cut up a large-stalked plant like maize into half or quarter-inch lengths, it is not surprising that Professor Moser met with such a wasteful result when using a bundle of unchopped maize.

Another German experiment is that by Professor Weiske, on sainfoin. The first half of this table shows the composition of the dry matter in fresh sainfoin, as compared with an equal weight of dry matter in ensilage made from the same sainfoin; and it might be assumed, from a hasty glance at the two sets of figures, that there is a considerable increase in some of the constituents; and, although some loss is obvious in others, yet there is nothing to indicate that the total is any way diminished. This is owing to the fact that, although you know the weight of the ensilage as taken out of the pit, you do not know what the fodder weighed when it was put in. The second half of the table supplies this deficiency, for it shows the weight of the dry matter in the fresh fodder on being put into the silo, and the weight of what remained, when it was taken out in the form of ensilage.

	Composition of 100 parts of dry matter in		100lb. of the dry matter of the fresh fodder yielded		Gain or Loss.
	Fresh sainfoin.	Ensilage.	When put in silo.	As taken out of silo.	
Albumenoids	18·56	20·44	18·56	15·53	— 3·03
Fat	2·89	6·02	2·89	4·57	+ 1·68
Soluble carbo-hydrates	38·60	30·88	38·60	23·47	— 15·13
Fibre	33·93	35·18	33·93	26·74	— 7·19
Ash	6·02	7·48	6·02	5·50	— 0·52
	100·00	100·00	100·00	75·81	

Here it will be seen that, although the fat is apparently increased, there is, on the whole, a loss of 24 per cent. of dry matter in the ensilage; and the right-hand column will show in what way the loss is apportioned. This table marks in a very instructive manner the importance of comparing ensilage with its *equivalent* of the green stuff it was made from, instead of taking equal weights of each, as is usually done.

If ensilage prove a failure, this is the direction in which its defects must be looked for; and from a consideration of analyses like the above, I am convinced of Goffart's wisdom in insisting on heavy weights. It must be borne in mind that none of the foregoing analyses apply to well-made ensilage—at any rate, to the extent there set down—since heavy weighting did not form a feature of the experiments quoted. They therefore mainly apply to those who refuse to recognise the importance of great pressure. M. Goffart asserts, and M. Barral, the chemist, supports him, that the above is by no means a fair representation of what takes place in well-made ensilage; and M. Grandeau, another eminent French chemist, shows by the following comparative analyses of fresh and siloed maize from M. Goffart's farm at Burtin, that the amount of alteration is relatively small:

Maize.	Water.	Sugar.	Albumenoids.	Soluble carbo-hydrates.	Fat.	Fibre.	Ash.	Acid.
Natural state	81·28	0·58	1·22	10·41	0·25	4·98	1·29	0·00
Ensilage	81·28	0·15	1·24	9·58	0·36	4·91	2·25	0·23

From a study of the above analyses it will be evident that, whether the loss in ensilage be great or small, it always is in

the same direction; that is to say, it always falls heaviest on the members of the closely-allied group—the sugars, starches, and cellulose (fibre or cell-substance). As a good deal of the starch and a portion of the cellulose are destroyed to produce successively sugar, alcohol, carbonic acid, and, if air be present, acetic acid and lactic acid also, the nitrogenous substances, being more stable bodies, appear by contrast to rise in amount. The ash receives a similar apparent increase, as well as an actual increase, frequently, from dirt or added salt. The fat is the only normal constituent that can be regarded as increased in larger absolute amount after pitting; it appears to be formed, or something like it, by the changes undergone during fermentation.

The tendency of fermentation to break down and render soluble the fibre of the pitted food is a most valuable feature in ensilage. Comparative analyses by Grandeau and by Lechartier; the results obtained by Dr. Cameron, with the Irish rye-grass experiments; Mr. Sutton's analyses of Lord Walsingham's ensilage—all show this property of prolonged fermentation. The object of digestion is to convert food into a condition that is soluble in the juices of the body; and that portion of the substance which cannot be so dissolved is not only useless but objectionable, as having a tendency to exhaust the animal by labour in vain. It further hinders the digestion of substances that are very nutritious in themselves, by encasing them round, as is seen with seeds, which frequently pass unaltered through the animal, whereas, if crushed or husked, they would be very valuable food. The experiments of M. Grandeau and Mr. Sutton indicate that there is more soluble matter in ensilage than there is in the dried or green fodder—reckoning, of course, pound for pound of the dry matter in each. Whether it is always so, when we compare grass or hay with the weight of ensilage that would have been produced if these had been put in the pit, is the great unsettled question, around which turns the whole economical value of the process.

The view, then, that I take of the ensilage process is this—That those who feel inclined to shirk in any way the imposition of the weights necessary to compression will be ill-advised in trying the process at all; for, economically, it is not likely that their endeavours will prove profitable in the long run. They may see distinctly enough the mouldiness or putrescence that is upon the surface, and may estimate its amount as compared with the mass

of apparently sound food that is in the pit; but it will be well for them to bear in mind that they only observe a portion of the mischief, and this may represent but a minor part of the actual waste, if regard be paid to the loss which has been going on in unseen parts of the silo, in consequence of a defective mode of carrying out the process. If, however, the fermentation be skilfully controlled, there appears to be no reason why the improvement in quality brought about in the mechanical condition of the food may not more than compensate for the loss in quantity, considering the very large margin of undigested matter which coarse fodders contain.

Ensilage, has, moreover, the advantage, of saving labour, and of being independent of the weather; and these two are in themselves sufficient to counterbalance a considerable amount of the loss that takes place in the silo. Of the profitableness of ensilage in the United States, Commissioner Loring's report says, "Not a doubt exists, certainly not a dissenting opinion;" but, of course, a large amount of this unanimity lies in the fact that American farmers can grow a cheap crop like maize, and store it up as they never could do before.

It is much to be hoped that those who make experiments on ensilage will, for the benefit of their fellow agriculturists, keep records of the cost and results of their trials; and, if they do go so far as to have analyses made, let them always endeavour to make them comparative, either by sending hay made from forage cut at the same time, or by having a sample of fresh grass analysed at the time when it is put in the silo. Whether ensilage be for our good, or be harmful, it is alike needful that we should quickly know its real nature; and a deep debt of gratitude will be owing to those pioneers who test it.

IV.—Ensilage versus Hay.

When the ensilage discussion assumed very great prominence, in the autumn of 1882, it fell to my lot to analyse a number of samples of this novel feeding material, and when the subject had for the time exhausted itself, I took the opportunity of reviewing the *pros* and *cons* of the matter, so far as I felt warranted by my own experiments or those of investigators in countries where the process was well known.

The year that has passed (1883) has not been characterised by the same discrepancies in practice and opinion, and there is consequently less excuse for critical observations. Nevertheless, ensilage is still in its infancy; and it may be of service to many who intend to experimentalise during the coming season to have put before them certain points that probably will be rather outside their own particular line of observation. Certain fallacies to be found in estimates of the cost, value, yield per acre, and comparative feeding merits of ensilage, practical men may be relied on to detect for themselves; but there are many points connected with the chemistry of the question which, though really of practical importance, the majority of agriculturists most certainly do not appreciate.

In a previous article on the "Chemistry of the Silo" it was pointed out that "if freshly-cut plants, containing one ton of solid matter be buried in a pit, under no circumstances is it possible that a ton will be taken out; but the more perfectly the air is excluded the nearer to a ton the mass will weigh."

This statement, which is at variance with what is said by some enthusiastic admirers of ensilage, is borne out by every comparative analysis that has been made, and can easily be proved by anyone who cares to embed deep down in the centre of his silo a weighed quantity of grass, and re-weigh it at the end of the experiment. A sack (waterproofed, if possible, to prevent juice gravitating to bottom of pit, but so arranged that the contained air could be well pressed out at the mouth of sack) would, if filled with grass, be a convenient method of testing this point, which is important as concerning the economic value of the process.

There are several points of practice bearing on this question of loss, which have been recommended, but which, from a chemical point of view, seem unadvisable, as calculated to render this loss of weight unnecessarily large. One of these is adding chopped straw or chaff to the fresh fodder when placing it in the pit. Goffart found, from comparative experiment, that the more straw he added, the worse the ensilage kept. A recent experiment of Dr. Märcker, director of the Government experimental station at Munich,* seems to place this beyond dispute. He experimented on siloed beet residues, and the following table will show the per-

* Abstracted in Biedermann's *Central-Blatt für Agricultur-Chemie*, February, 1883.

centage of loss on the fresh substance, by burying it in a silo with and without an admixture of straw:

	Loss on portion Without straw.	Loss on portion With straw.	Increased loss by addition of straw.
	Per cent.	Per cent.	Per cent.
Fresh substance	19·3	23·5	4·2
Dry organic substance	21·8	29·0	7·2
Fat	+60·0	+15·7	—
Fibre	10·0	23·6	13·6
Nitrogenous substances	9·1	24·6	15·5
Non-nitrogenous substances	28·8	32·6	3·8

Another cause of excessive loss in a silo is very probably due to attempts to drain it. It must almost necessarily facilitate the admission of air, and it allows of the escape of juice. The following analyses I have made of two specimens of ensilage liquor, and of juice expressed from fresh grass, will show that this is far too valuable to be lost:

I. Ensilage liquor, amber brown colour, pleasant alcoholic odour, fermenting and giving off carbonic acid gas freely. Contained 5·17 per cent. solid matter, of which 0·98 per cent. was mineral matter rich in phosphates. It contained 0·588 per cent. of glucose.

II. Ensilage liquor, fermentation evidently progressed further than in last. No sugar. Acidity equal to 0·6 per cent. acetic acid. Contained 5·47 per cent. of solid matter, of which 1·39 per cent. was mineral salts.

III. Juice of fresh grass contained 7·02 per cent. of solid matter, of which 2·02 per cent. was mineral matter, and 2·08 per cent. sugar, calculated as glucose.

The above analyses will gain point if we call to mind that fresh grass only contains about thirty per cent. of solid matter, of which about two per cent. consists of mineral matter. Considering, too, that matter in solution is always more easy to assimilate than solid matter that has first to be rendered soluble, it is obvious that it must be wasteful to allow this juice to leak away, or to voluntarily squeeze it out from the fresh grass, as has been suggested.

Professor Märcker, in the paper above referred to on the preservation of beetroot refuse from sugar works, gives instances

of the loss incurred with this substance, as shown by the amount first put in being contrasted with that afterwards taken out, and points out that the greatest loss occurs in porous unwalled pits, and that to obtain the best results, air-tight and water-tight cemented silos are desirable.

The figures he gives are very startling, and it is to be hoped that they do not hold equally good of grass and English fodder crops; but it is certainly desirable that comparative experiments of a similar kind should be made to ascertain what are the facts. Undoubtedly they show the direction of the change that goes on in all silos, although it may differ in degree, and the results are, therefore, most instructive. The experiments were conducted at different experimental farms, except 4, 5, 6, and 7, which were all carried out at one farm, and exhibit the result of a bad system of procedure. The decimals have, for convenience of reference, been omitted.

Number of experiment.	Duration of experiment in months.	Loss per cent. of		Loss incurred on 100 parts of each of the dry organic constituents present in the food.			
		Original undried substance.	Dry matter.	Fat.	Wood fibre.	Nitrogenous substances.	Non-nitrogenous substances.
1	13	20	23	+105	9	11	31
2	9	44	46	+140	45	37	49
3	3	18	13	—1	13	11	14
4	$4\frac{1}{3}$	55	45	—32	40	35	49
5	$4\frac{1}{3}$	45	45	—44	40	28	49
6	$4\frac{1}{3}$	47	27	+26	14	4	35
7	$4\frac{1}{3}$	62	54	—52	52	37	56
8	$8\frac{2}{3}$	23	36	—23	36	31	32
9	8	19	21	+60	10	9	28
10	6	17	32	—8	31	40	30
Mean		35	34	+17	—29	—24	—38

The word "loss," as employed in the above table, and in all previous remarks, does not refer to damaged or moulded ensilage, involving a *virtual* waste of so much food, if unfit for consumption, but to an *actual* loss or dissipation of solid matter. As has been shown by the experiments of Lechartier (quoted on p. 167), and which I have myself been able to confirm by analysis of air drawn from the heart of a freshly opened silo, some of the solid matter of

ensilage is constantly "evaporating" away, as it were, in the form of carbonic acid gas, nitrogen, &c. The loss falls heaviest on the carbo-hydrates, such as starch and sugar and cellulose; consequently, *pound for pound*, ensilage may appear more nitrogenous, and therefore a more meat-producing food after storing than before. Unless, however, the ensilage is purchased, it is necessary to bear in mind that, even if the quality is improved, the quantity is decreased. Moreover, even the nitrogenous substances by no means escape without loss. A portion disappears entirely, a further portion becomes changed from albumenoid substances, of great value as flesh-formers, into substances probably akin to ammonia, which are chiefly of value as stimulants, and can only replace albumenoids in food to a limited extent. Professor Kinch, of Cirencester, recently pointed out an instance where the percentage of true albumenoids had diminished 50 per cent. from this cause. The increase, too, which appears under the head of "fat" is chiefly due to butyric and other acids formed by fermentation, which chance to be extractable by the same procedure as the true fat. It is therefore probably a fictitious increase, so far as true fatty bodies are concerned. It is from considerations such as these that chemists are apt to regard the ensilage process with suspicion, unless feeding experiments or some tangible practical data accompany the results of the operation.

Whenever chemical action takes place, changes in temperature are produced; and an accurate determination of the temperature inside a silo will serve as a measure of the amount of change going on, and the circumstances under which these changes are most active. Not many data of this description are accessible, and some of those that have been published over here give temperatures so much higher than those of skilled experimenters abroad as to suggest that the ensilage was not of the best and most economical description.

The Ontario Experimental Farm (which, under the able direction of Mr. W. Brown, has been doing some exceedingly good work of late) undertook, in their silo experiments, to keep a record throughout of the maximum and minimum temperature in various parts of the silo. They seem to be the most elaborate that have yet been published, and are worthy of careful attention. The rather regrettable discrepancies to which attention is here drawn by an asterisk mark are probably only printer's or clerical errors.

		Temperature inside the Silo. Top.	Centre.	Bottom.	Mean temperature outside.
1st week	Highest	71°	92°	65°	52°
	Lowest	63	89	64	
	Mean	67	91	65	
2nd week	Highest	67	91	65	40
	Lowest	53	86	63	
	Mean	51	88	64	
3rd week	Highest	62	88	64	42
	Lowest	53	86	63	
	Mean	55	87	63	
4th week	Highest	59	93	68	41
	Lowest	58	92	67	
	Mean	58	92	67	
5th week	Highest	64	89	66	39
	Lowest	57	79	64	
	Mean	60	84	60*	
6th week	Highest	56	87	67	25
	Lowest	46	81	64	
	Mean	52	84	62*	
7th week	Highest	56	84	66	43
	Lowest	54	78	63	
	Mean	55	81	64	
Last week			73	—	26
Average for whole period		58	87	61*	

Stress has been laid, in the previous pages, upon the insidious "evaporative" or fermentation loss that goes on in silos, mainly because it has been overlooked by so many other writers, while farmers in general either disregard it entirely or look upon any shrinkage in weight as though it were merely due to loss of water. It is time they should clearly understand that the solid constituent originally built up out of the carbonic acid in the air is resolved back into this gas by fermentation. There is more fermentation in the silo than ordinarily takes place in hay-making, and consequently there is (independently of loss of water) *a greater loss of weight of solid matter in the silo than usually occurs in the hayrick.* I think that if farmers once fairly grapple with these facts—checking them, if they can, by experiments of their own—the views of many enthusiasts on ensilage will have to be moderated, and especially those who advocate the adoption of whatever seems cheapest and least troublesome.

* Those figures marked with the asterisk are given as in the original; but there is evidently some error, as the mean is stated to be less than the lowest; and in the last line, applicable to the whole period, the temperature at the bottom is several degrees less than the average of the figures given above.

The dark brown, aromatic smelling ensilage, produced when considerable heating takes place in the fermenting mass, shows this loss in the highest degree, because the high temperature can only be produced by consumption of the fodder. Being commonly dry and hay-like, keeping well out of the pit, such ensilage is usually in highest favour. From an economic point of view, however, the green, fresh substance, obtainable by care and heavy pressure, is far preferable. It is distinguished by little smell or taste when taken out of the pit, and the temperature is low. Mr. Grant's ensilage may be mentioned as an excellent specimen of this class, as is the Vicomte de Chezelles' of the brown variety. Some distinctive marks in composition will be seen on reference to analyses given on page 232. It is for the practical man to determine to what extent this loss is permissible. If good ensilage can be made where the hay crop would be a failure; if it can be prepared at a considerable saving in labour and expense; or, if for dairy or other special purposes it is better adapted to a farmer's requirements than hay or roots—then a moderate amount of waste may not be incompatible with even an ultimate profit.

To solve this difficult matter one requires, above all, an accurately carried out and strictly comparative series of feeding experiments. Moreover, the meat or milk producing power of the competing foods should not be reckoned on the ton of food supplied, but should be calculated back, if possible, to the yield per ton of fresh produce in each case, or to the yield per acre. We should then be working with fairly definite quantities.

Even accurately conducted experiments, as above suggested, would not necessarily settle the question absolutely, for this reason: Ensilage, when once we know the most economic mode of preparation, can apparently always be reproduced of very similar quality; whereas with hay, unless we have a substitute sun in the form of a hay-dryer, there must necessarily be vast difference in quality, according to the nature of the weather at the time of harvesting. Hence ensilage should not be judged in comparison with the best hay, but with the average of hays as we get them on contrasting one year with another. On the other hand, unfavourable weather, or a desire to obtain a heavy crop, causes grass cutting for hay to be delayed till the grass is over-ripe and stemmy, whereas ensilage is usually made from grass at the time of early bloom, and it is scarcely fair to compare hay made from over-ripened grass with ensilage made from less aged and more nutritious material.

The best hay suffers little loss of nutriment in drying. By artificial heat in the laboratory one can even so contrive that it loses none whatever; but even in practice it does not exceed 2 or 3 per cent. of solid matter under favourable circumstances. Carefully conducted experiments on the feeding value of fresh grass as compared with hay made from the same grass *at the same period of growth,* do not confirm the popular view as to the great loss of digestibility produced by the mere operation of drying. Practical farmers are apt to overlook the fact that the statements of men of science are backed up by experiments expressly carried out with the view to secure exact conditions of equality, whereas the farmer's belief is for the most part based on the circumstance that cattle are found to thrive better on young and succulent pasture than when fed upon hay made, not at the time of the grass being young and succulent, but at a much later stage of growth. They are, in fact, comparing incomparables. In this way it is impossible to ascertain the real effect of drying, for the percentage of digestible matter, which may amount to 75 per cent. in the one condition, is sometimes reduced 50 per cent. as the grass increases in age. One may, moreover, when the weather is unfavourable, lose one-tenth or more of the total constituents of the hay before it is stacked (as was shown in an article of this series published in the *Field* of Sept. 16, 1882), and this portion, too (as was illustrated in the same article by some striking feeding experiments, carried out by Dr. Voelcker), may contain so large a proportion of the nutritious part of the hay that the residue left is almost valueless as food, and, though taken in unlimited quantities, the animals fed on it may actually lose weight instead of putting on fat. Of course this applies with equal force to ensilage, if the crop, after cutting, has been left long exposed to the vicissitudes of the weather, before being put into the silo. An instance of this kind occurred at the South Hetton silo, where the crop, when originally cut, had been intended to be stacked, but, owing to the rain, it lay on the ground from the beginning to the end of September, and eventually was put into the silo. The result was that, when the silo was opened, and the cows were fed upon such washed-out residues, they became constipated and lost condition, so that it was found necessary to reduce the amount of ensilage and give other food to remedy the evil.

In addition to rain, that washes out the bone-forming phosphates,

and readily-digested sugars, &c., hay suffers at times considerable loss by fermentation in the stack. The following is an analysis of two portions of hay, taken out of the same rick. The one was light yellow, and of moderate quality; the other of a coffee-coloured brown, with a pungent odour, characteristic of aldehyde, an organic substance intermediate in composition between alcohol and acetic acid. By immersing in cold water some of this hay fresh from the stack, and gently warming the distillate therefrom with ammonia-nitrate of silver, I was enabled to obtain a silver mirror on the side of the glass test-tube—a reaction confirmatory of the presence of aldehyde. Aldehyde is only formed when oxydation has taken place in a limited or insufficient supply of air or oxygen, and consequently shows that change was going on in this portion of the rick greater than the current of air produced by a powerful fan and engine could keep up with.

Analysis of Two Samples of Hay from the same Rick.

The original substance of the two samples contained respectively per cent.:	A. Yellowish Hay.		B. Brown or Fermented Hay.	
	Undried.	Dried at 212° F.	Undried.	Dried at 212° F.
Water	15·20	—	12·80	—
Albumenoid substances*	10·31	12·06	10·51	12·05
Ether extract (fatty matter)	1·84	2·17	3·71	4·26
Free acetic acid	1·60	1·89	4·69	5·38
Sugar and sugar-forming substances (starch-like substances, &c.)	13·47	15·88	9·03	10·36
Other non-nitrogeneous extractives	23·02	27·25	21·61	24·77
Fibre	26·97	31·80	29·43	33·75
Mineral matter (ash)	7·59	8·95	8·22	9·43
	100·00	100·00	100·00	100·00
* Containing nitrogen per cent.	1·62	1·90	1·66	1·90

It is noticeable that the loss in the fermented hay fell chiefly on those carbohydrates that are convertible into sugars; and further examination showed that it was the starch-like substances (insoluble in cold water) that most suffered; for, whilst the yellow hay contained 12·46 per cent. of starchy bodies, the dried brown hay contained but 3·42 per cent.

Of glucose (one of the true sugars) the yellow hay contained $3\frac{1}{2}$ per cent., but the dark fermented hay scarcely any. Instead, it

contained some products of decomposition, doubtless akin to dextrin, which, by boiling with weak sulphuric acid, produced the same effect on Fehling's sugar test as 7 per cent. of glucose. Ensilage commonly shows a loss of sugar similar to this brown hay; but unless the original fodder was exceedingly poor in carbohydrates, or the fermentation is carried further than is at all necessary, I have not found that the sugar entirely disappears.*

The facts regarding brown hay being of practical importance, from the fancy that some farmers exhibit for such fermented or "heated" hay, an attempt was made to ascertain the total amount of organic substance thus lost. As it was of course impossible to obtain any of the fresh grass from which the above hays were made, an excellent specimen of green hay from an adjoining rick, made from the same field and at the same time, was also examined. It was found to possess only 8·3 per cent. of "ash" or mineral salts; and as this would be a constant quantity, the presence of 9·43 per cent. of "ash" in the fermented hay made it evident that this apparent rise was occasioned by a loss of organic substance equal to 13 per cent. of the whole dry matter.

The indigestible fibre was likewise 29 per cent. in the greenish sample of good quality, as contrasted with 33·75 in the brown sample, or an increase of 16 per cent., thus showing that the loss by fermentation in the case of hay falls chiefly on the most nutritious constituents and renders the final product less digestible.

The Neilson system of haymaking, whereby the hay is stacked damp, and the air drawn from the centre of the rick by an exhaust fan, depends for its success on the heat given out during fermentation. One is, in fact, burning up one part of the hay to dry the other. As pointed out by me in the Haymaking articles of this series, this is a defect in principle that is open to grave objections.

The yellow and brown samples above mentioned were taken from a Neilson rick, the green was sun-dried in the ordinary way. In order to prove conclusively that organic matter is dissipated by this process, it appears of interest, not only to examine the hay, but the products that were being drawn out by the fan. If the carbonic acid, nitrogen, organic acids, &c., thus given off be collected, it would be found to fully account for the actual loss estimated by analysing the hay. It is not, of course, possible to

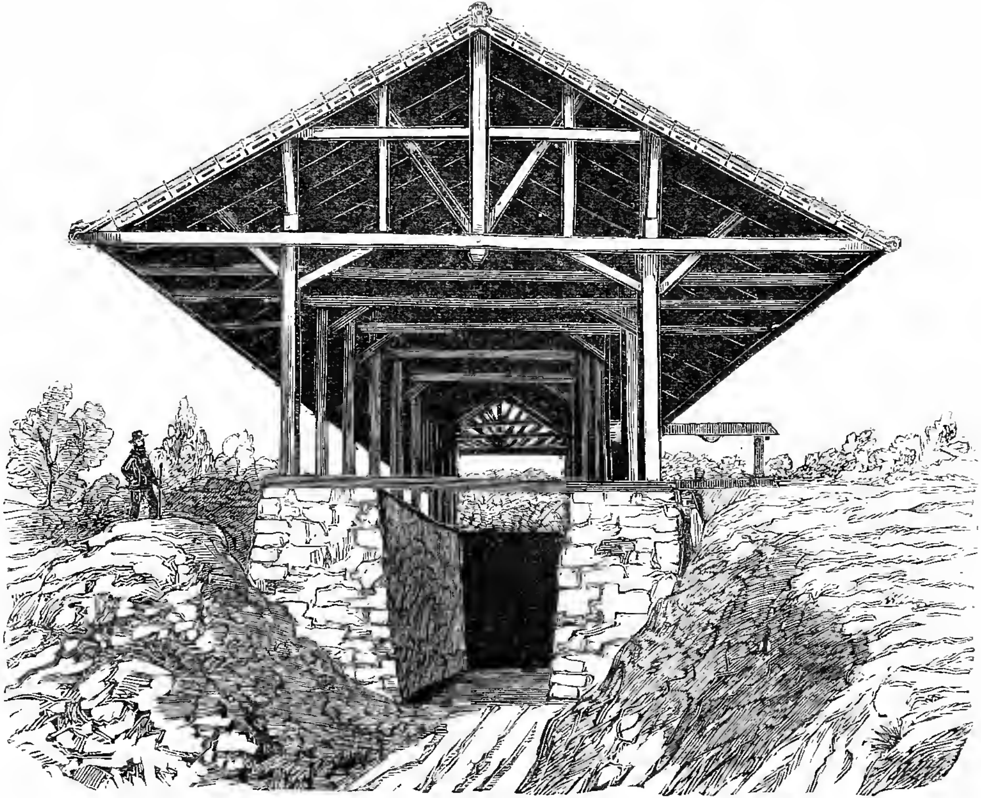
* A substance was here classed as a sugar if it reduced the Fehling sugar test, was soluble in alcohol, and was not precipitated by a solution of acetate of lead.

go quite so far as this with a haystack; but Dr Percy Frankland, experimenting on small quantities of grass, has shown that, in the presence of air, oxygen is absorbed and large amounts of carbonic acid evolved. Nitrogen is also liberated from fermenting grass, showing a destruction of albumenoids. Small quantities of hydrogen and other combustible gases were evolved at the same time.

I have myself had the good fortune to procure from a Neilson stack three samples of water that had condensed in the fan-box outside the rick. The liquids, in addition to a small amount of waxy matter (probably mechanically carried out of hay by the steam), contained also minute quantities of acetic acid and alcohol. One thus sees not only that solid matter disappears, but in what fashion it may escape into the atmosphere:

	Alcohol.	Acetic Acid.
Oct. 16. Water condensed from steam drawn by exhaust fan out of a rick of meadow grass, recently stacked in a green and dripping wet condition, contained per cent. ...	trace ...	0·01
Nov. 1. Water from same stack. Temperature of rick, 150° to 160° Fahr.; ditto of exhaust tube in centre of rick, 135° Fahr.; vacuum, 22lb. per square foot	0·21 ...	0·21
Nov. 10. Water from same rick. Temperature, 155° to 170° Fahr.; ditto of exhaust tube, 140° Fahr.; vacuum, 22lb. per square foot	0·08 ...	0·31

From the above facts it will be evident that neither ensilage nor hay can be in any way held up as a perfect process; but, as the good points of the one often come out most conspicuously under circumstances when its competitor is at its worst, it will probably be found most difficult to frame any conclusion likely to be universally applicable. Many of those who experimented last year with ensilage seemed abundantly satisfied when they turned out a something that was not a mass of corruption, but a substance that animals relished and throve on. From this point of view, the year's experiments have certainly been most successful. Having had the opportunity of inspecting some couple of score of specimens sent at various times to the *Field*, I can speak with confidence of the large proportion of excellent samples produced, and the very small percentage of failures. These experiments also confirm all previous warnings as to the advantages of heavy weights and well-constructed silos. It is to be hoped that the experiments of the coming season will not only show that ensilage is easy to make, but will answer the questions, What does it cost, and what is it worth?



VICOMTE DE CHEZELLES' SILO.

APPENDIX.*

THE SILO OF THE VICOMTE DE CHEZELLES.

[This silo—which is, we believe, the largest single silo in the world—was first brought to the notice of English readers by an article in the *Field*, accompanied by a woodcut, here reproduced. Mr. H. Kains-Jackson has returned to the subject on several occasions; and from his various articles we make the following selections.]

By the courtesy of M. le Vicomte de Chezelles, I am enabled to give the following particulars as to his large and practical working of the system: Under date, July 31, 1882, the Viscount writes me, from near Chaumont-en-Vesin, Oise, that harvest work is in full swing on his estate, and so he has time to send only an account of the principal features of his mode of ensilage. A large photograph accompanies the letter, and the illustration given is on a reduced scale, but sufficiently indicates the construction of the silo. M. de Chezelles writes:

"I cut all sorts of forage with one of Wood's mowers, and five men follow the machine to load the carts, which at once convey the crop to the silo, where a powerful chaff-cutter cuts up the forage as fast as three men can feed it, whilst two other men unload the carts. The above ten men work together, being paid by the job, their wages being commonly about 8*s*. per hectare (about 2½ acres), the pay varying according to the nature of the crop.

"I so arrange the number of carts and horses, reckoning the distances of the fields from the silo, that there may be a continuous supply furnished to the chaff-cutter, which should work on without interruption, as by this means the ensilage is made regularly and economically in a very few days. As a matter of fact, in this way I have cut, carried, and formed into ensilage the produce of about 170 acres of trifolium, sainfoin, lucerne, tares, and artificial grasses.

"For the silo two men are wanted to level and stow the cut forage as it falls from the chaff-cutter. Twice a day a couple of bullocks or horses are driven over the ensilage, so that it may be trodden down evenly. This work is better done by animals than by men. An occasional sprinkle of salt gives a savour that animals appreciate.

"My silo is 72 yards long by 6½ yards wide, and 4½ yards high. It is desirable to raise the layers of forage a yard above the top level of the

* The articles in this Appendix are mostly reprinted, in a more or less condensed form, from the *Field*, or have been specially written for this book. When quotations are made from other publications, the name of the paper is given.

silo, and this quantity above the surface is inclosed with boarding. By shrinkage and settlement the ensilage soon sinks to the pit level. Directly the silo is full, I at once have it covered as soon as possible with a bed of earth about a foot thick, and the forage is then left for some three months, to become ripe for feeding of stock.

"For two years I have now successfully fed all my farm animals, consisting of 20 horses, 36 bullocks, 120 milch cows, 1000 to 1200 sheep and lambs, with this ensilage, mixed with straw and roots; in the feeding of horses I mix carrots or potatoes with the forage. All the stock have been kept in thriving condition—indeed, they have been wonderfully well whilst fed on this green food stored in pits."

One of the first impressions in reading the above letter was that the scale—nearly 200 acres of crops being saved—brings the subject at once under practical agriculture; and next that horses can be fed with as much advantage as cows upon ensilage. Hitherto I had regarded the process as more interesting to dairymen than to ordinary farmers. Lastly, in point of expense, reckoning 10*d.* to 1*s.* 3*d.* per ton for reaping, carrying, and cutting (the chaff-cutter should be driven by a steam engine), makes the system the most economical of any.

I have just visited (October, 1882), probably the largest silo in Europe—that of the Viscount Arthur de Chezelles, of Château Boulleaume, Oise, France. It is really a fine yet most economical structure—an excellent barn and perfect silo; a great oblong shed, roofed with tiles, 72 yards long, 6½ yards wide, 4½ yards high from the ground level—an immense cover for the cereal crops of a large farm. The floor is sunk some 12ft., and is paved and drained. The side walls and one end wall are lined with rough stones set in mortar, whilst the front is partly walled up, and a wide door allows the entrance of trucks on rails to come and be filled. This great basement suggested comparison with the hold of a big ship; and in it at present is stowed away the produce of 170 acres of various sorts of forage—cut, carried, and made into green chaff last July—which fills the whole space, excepting where a remnant of last year's ensilage occupies some 16ft. at one end.

The forage was cut by English mowing machines; five men followed them and loaded into carts, which delivered the green stuff at the side of the silo, upon the carriers of a powerful "Albaret" chaff-cutting machine, two men unloading and three men feeding; so that ten men were employed, and these were paid 8*s.* to 16*s.* per hectare (2½ acres), according as the crops were light or heavy. The whole business was so arranged in relays that the work went on uninterruptedly, and the chaff-cutter, driven by 7 h.p. engine, poured out a green stream of food that, like water, soon became level through being trimmed and stowed by a couple of workmen. Twice a day bullocks (here much used for farm work) walked over the mass and gave it compactness. A little salt was

occasionally sprinkled on the layers, more to give the fodder an appetising flavour than for any other purpose. When, in a few days, the silo was filled—swallowing up all and whatever the farm could give it—the forage was covered up, without any layer of straw or boards, by a stratum of the light sandy soil, some foot and a half thick. Naturally the mass subsided under the weight of earth, and became nicely compressed, but scarcely more than is hay in a large stack.

At this period, to all intents and purposes, the superstructure became and looked simply a great shed with a nice even sandy floor; just the place to invite the reception of the cereal crops which—wheat, oats, and some barley—were ripening in the fields. In a short time, from floor to the angles of the roof, the building was filled.

I fancy there are not three farmers in England who would have had as much faith as had the proprietor of this estate, when he confided the produce of 170 acres of land to this great pit in such conditions; but two years' previous experiments gave confidence, and a large and valuable bulk of property was left in the full expectation that for this coming winter a wholesome and nutritious store of animal food would be available for his stock. That such expectation was fairly fulfilled I went to see for myself.

Previous to my arrival at Liancourt St. Pierre, I had received a letter from M. Georges, the manager of the farm, to say that, owing to the abundance of green keep still in the fields, the opening of the silo would be postponed until November. However, upon the day I had come to see the actual opening, the silo, by the courtesy of the Vicomte, was opened, and on the 12th of October, 1882, I had for the first time a block of new ensilage in my hands. I took it at once to a yoke of Charolaise oxen that happened to be within a short distance, looking, with the great cart loaded with beetroot pulp, a picture from out the canvas of Rosa Bonheur. These bullocks took the ensilage, eating it with relish, as a horse takes a mouthful of hay from the hands. All doubt as to the food being freely taken was therefore at an end. To reach the ensilage, a load or two of the superimposed corn had to be removed; next the stratum of earth was shovelled aside, and the brown-black mass of ensilage below was laid bare. Without the loss of a minute I jumped down into the pit, thrust my hands between the substance with some difficulty, from its compressed state, and found the temperature decidedly high, certainly of blood heat, whilst a smell rather agreeable than otherwise, such as comes from breweries—sweet, alcoholic, and condimental—made itself observed. The heat gave no apprehension, and was not considered objectionable, previous years' experiments proving such condition was unattended by danger. Without further delay, I took, as a geologist takes a fossil specimen from a freshly cut rock-section, three samples of the new ensilage, and a fourth sample of the old (1881) stock, and placed them in separate tin cases, which were only closed with string, since I feared to have them soldered down on account of possible difficulties with the Custom House authorities. The work so far was complete, and the opening of the silo that Thursday

afternoon was a success; the food stored there was good provender for the coming winter. The instance, in this present case, is all the more notable, because, whilst different experimentalists have advocated various plans as to method of covering, necessary weight, time and manner of opening, and divers details, here there was an absence of all niceties; here was a working example that all practical farmers could easily follow. Simplicity, efficiency, and economy were the characteristics of the silo-work at Chateau Boulleaume.

I next put forward a supposed difficulty—namely: that the bulk of ensilage, from which a portion was cut away, must on each occasion be protected afresh, and such portion taken away must be consumed in twenty-four hours, or it would become worthless. Nothing of the sort was to be feared, as I was told, from the experience of last season. The ensilage is simply cut away as wanted, just as a few trusses of hay would be cut from an ordinary stack. After a lapse of eighteen days, one of the samples on view in the Corn Exchange, Mark-lane, on Mr. Gripper's stand, retains sweetness and savour, as many visitors attested. An analysis has been made, and why it was not made before was told the readers of the *Field*—our Custom House sentinels stopped and challenged the new visitor I had sent to England, and thought he was "tobacco" in disguise.

INVICTA.

ANALYSIS OF VICOMTE DE CHEZELLES' ENSILAGE.

The following tabular statement represents the percentage composition of the samples of fodder, consisting of trefoil, lucerne, tares, and grass, cured on the ensilage system by the Vicomte de Chezelles.

Volatile Matter:			
Water		50·30	per cent.
Free acetic acid		1·20	,,
Alcohol		1·80	,,
Solid Matter:			
Albumenoids*		9·12	,,
Ammonia		0·06	,,
Fatty matter		2·07	
Soluble carbo-hydrates:			
Sugar (maltose)	2·94		
Starch and digestible cellulose	2·23		
Pectous substances (gum, mucilage, &c.)	10·32		
		15·49	,,
Insoluble carbo-hydrates (fibre)		14·35	,,
Mineral matter (ash)		5·61	,,

* Containing nitrogen, 1·44 per cent.

The following represents the composition of the substance (when dry) contrasted with two samples of dry lucerne analysed by Dr. Von Wolff, of the Hohenheim Imperial Experimental Station, Germany. The first sample was dried with care on a barn floor; the other (a portion from the same crop) was dried in the field in the ordinary way. During the first two of the four days to which the latter sample was exposed to the

atmosphere, it became subjected to the action of a slight shower of rain and to a thunderstorm:

	Ensilage.		Carefully-dried Lucerne.		Field-dried Lucerne.
Albumenoids.....................	18·35	......	17·00	......	14·94
Fibre	28·87	......	31·81	......	33·90
Fat, Soluble Carbo-hydrates, and Alcohol (if any)	38·95	......	43·80	......	44·22
Ash.................................	11·29	......	7·39	......	6·94

The above figures so clearly show the high feeding value of this sample of ensilage, that they may be allowed to speak for themselves. I wish only to point out that, contrary to generally accepted opinion, my experiments led me to believe that the sugar formed by the fermentation of ensilage is not "grape sugar" or "glucose," but sugar of malt, or "maltose." The acetic acid, although of course indicative of the loss of nutritious feeding material, is probably not without value as a condiment. Its amount in the above sample is much less than in the specimen of highly fermented hay, the analysis of which was given in my "Chemical Investigation of Hays" (*The Field*, Oct. 14, 1882).

F. Woodland Toms, F.C.S.

7, Busby-place, Camden-road, London, Nov. 2, 1882.

[A careful botanical examination of the above sample of ensilage afterwards showed that, although various crops, as already stated, were stored in the silo, they were by no means equally distributed, and that the sample analysed consisted mainly of clover (Trifolium pratense), with a small admixture of barley and some of the common grasses, such as Alopecurus pratensis, Agrostis albus, Bromus mollis, &c., all cut up into chaff before being put into the pit.]

Statement of Cost of Vicomte de Chezelles' Silo.

I give below the detailed cost of the silo at Château Boulleaume, Oise, France, the particulars and figures being copied from a statement affixed in the Paris Show at the Paris Exhibition of Ensilage, made by Vicomte Arthur de Chezelles, and appended to drawings and photographs:

	Fr.	ct.	£	s.	d.
Silo of 1475 tons capacity, suitable for containing the produce of 250 acres of forage, costing 2fr. 70c. for each ton, or 3989fr. 48c., say sterling			£160	0	0
Excavating and carting earth (1368·80 mètres), at 65c. ...	889	72			
Concrete for foundations and floor	86	40			
Masons' work, 4fr. the mètre—435·56 mètres	1742	24			
Cartage of stones (dug out from the estate), lime, and sand, 2fr. the mètre	871	12			
Wood around the pit, 5 steres, at 60fr.	300	0			
Fixings of iron, and Roman cement	100	0			
Fr.	3989	48	£160	0	0

Barn Superstructure, to shelter about 20,000 sheaves:

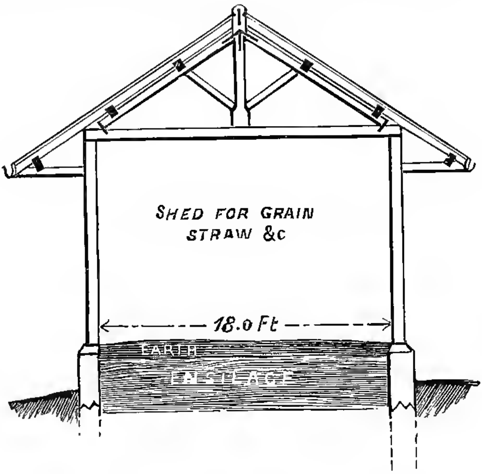
	Fr.	ct.
Elm posts, 11·865, at 86fr. the cubic mètre	1008	52
Woodwork of Norwegian pine	2050	43
Carpenter's labour	750	0
Bolts and nails	400	0
Blacksmith's work	180	75
Tiles and laths	1629	0
Laying tiles	235	0
	6253	70

Total cost......Fr. 10,243 18 say £410

Estimate for a silo that would hold the produce of 125 acres, and without superstructure, 80*l.*

Specification for Building a Chezelles' Silo.

In the specification of the "Chezelles Shed and Silo," the plan is simply reduced in size from the large one previously given, in order to make it suitable to most English farmers. As will be readily seen, the eaves could easily be extended, and the sides inclosed, so as to form a roomy stable or dairy and cow shed at very small cost. This building commends itself as economical and adaptable to most farm purposes.



Chezelles' Silo and Grain Shed.

Specification of Works required to be done in the erection of a grain shed and of a silo for storage of grass, clover, and other green forage.

Excavator.—Excavate to a depth of 9ft. and cart away the soil excavated to such place as shall be directed. The earth in the founda-

tion is to be well rammed down, so as to form a solid level flooring, in a natural bed, and not made up of loose earth. Sand, if found, is to be allowed for by the contractor.

Bricklayer, &c.—Build in Flemish bond the walls and piers, as shown, of best hard well-burnt grey stocks, laid in good cement composed of one part of approved cement and three of clean sharp sand, with footings composed of four courses of brickwork. Lay the bottom of the pit with concrete 1ft. in depth, with a layer of asphalte 1in. in thickness on top. Form a drain in the asphalte, and concrete through the centre of the pit the entire length, with a fall from either side of the walls, and a fall of 6in. from the centre towards each end. Provide and lay a damp course, consisting of two courses of unbroken slates, laid, breaking join in cement above footings.

Carpenter and Joiner.—Timbers are to be supplied and fixed of the following scantlings, well seasoned, free from large or dead knots, decay and all other imperfections: Tie beam 8in. by 2in.; king post, 6in. by 4in.; common rafter, 3in. by 1½in.; struts, 4in. by 2in.; ridge plate, 8in. by 2½in.; purlins, 4in. by 4in.; principal rafters, 5in. by 3in. Uprights (posts), 8in. by 6in., are to be placed at distances of 8ft. apart, and to be tenoned into wall-plate as shown. An oak wall-plate to be provided and fixed, size 8in. by 8in., to run entire length of wall.

Slater.—Slate the whole roof, as shown, with sound Bangor Countess slating, on fir laths, and fixed with galvanised nails. Provide and fix a slate ridge.

Founder and Smith.—Provide and fix a cast-iron ogee eaves gutter on each side of building, with a fall towards two cast-iron rain-water pipes at either end, as shown. Provide iron ties where shown.

General Remarks.—The whole of the work is to be carried out and finished completely from the time that it is commenced, without stoppage (through the fault of the contractor), and in case anything may have been omitted in this specification, that may or may not be shown in the drawing that is absolutely necessary for the stability of the erection, the same shall be executed by the contractor on written authority being given him.

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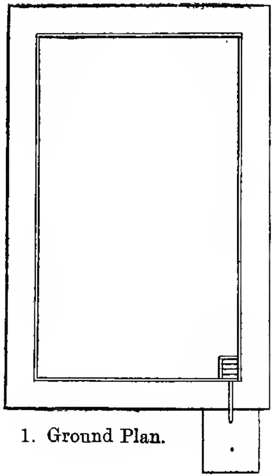
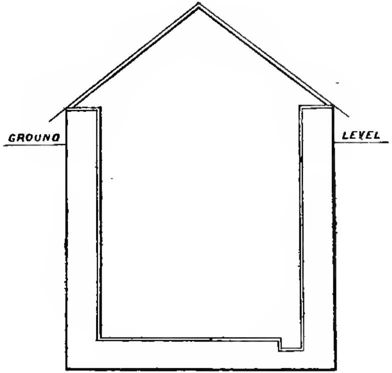
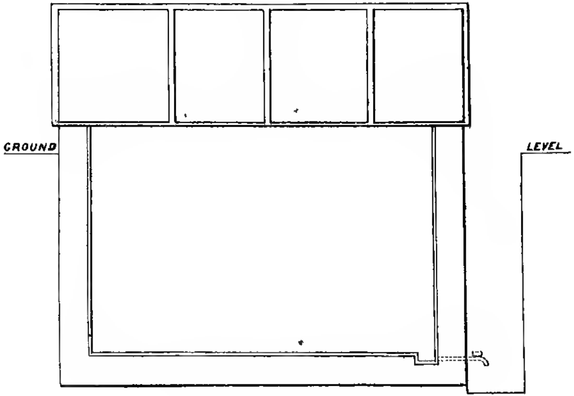


1. Ground Plan.

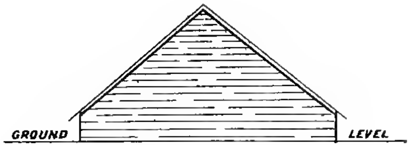


2. Cross Section.



3. Longitudinal Section.

4. Side Elevation.



5. End Elevation.

THE EAST COWTON SILO.

MR. COPLEY'S SILO AT EAST COWTON, YORKSHIRE.

[MR. THOS. EASDALE, dating from the Pepper Arden Hall Estate Office, East Cowton, Northallerton, wrote several letters on this subject in the *Field* of December, 1882, and January, 1883, the particulars of which we here bring together.]

THE preservation of green food for the use of cattle during winter having engaged a considerable amount of public attention for some time past, I feel sure that many of your readers will be interested to learn that a most successful experiment has been carried out close to this place by a neighbour of mine, who cordially permits the leading facts to be stated. They are as follows:

Some time in the early part of 1882, a copy of Mr. Bailey's (American) book on ensilage came to hand, which, after a careful perusal, was subjected to a searching discussion, in which it was my privilege to join. After all the *pros* and *cons* were well thrashed out, it was decided that a thorough trial should be given to the system so eloquently advocated by Mr. Bailey. It was also resolved that to this trial all possible intelligence should be applied, and that no reasonable trouble or expense should be spared.

The silo—the plan of which is a simple oblong, 12ft. in length, 7ft. wide, and 8ft. deep—was built during the month of June and early part of July, and was filled with grass during the latter part of August and beginning of September.

After sufficient additions had been made to the contents and the arrangements for compressing the grass were carefully adjusted, the whole thing was closed up on the 14th of September.

It was the intention at that time that the silo should not be opened until Christmas; but a friend, who was deeply interested in the experiment, called on the 25th of November, and would hear of nothing else but that the pit should be opened while he was here. My neighbour having consented, the thing was done; the result being—even to those of us who were believers throughout—a most agreeable surprise. The whole mass of ensilage was found to be in a perfect state of preservation, and gave forth a most pleasant aroma not easily described.

The cattle, on the first day of being offered it, were, as was expected, rather dainty, but on the second day took it eagerly, and by the end of the first week they had become as fond of it as they are of the best oilcake—in fact, they now eat it ravenously.

Both milk and butter have increased in quantity during the short time the cows have been fed with ensilage; while the quality of milk, butter, and cream continues all that can be desired.

The quantity of ensilage given to each cow per day is about 45lb. weight, plus the ordinary rations of the usual feeding meals or cake.

Chopping the grass was dispensed with. A man with a horse and cart followed two scythes; he forked the grass into the cart from the swath, and from this cart the grass was again simply forked into the silo.

My letter on this subject having brought forth very numerous inquiries from all parts of the country, including Scotland and Ireland, I have endeavoured as far as possible to cover the various questions put.

1. *Kind of grass used.*—Commenced with ordinary grass from roadside; then some of a stalky nature, and finished with strong aftermath.

2. *State of grass when put in silo.*—Some dry, other portions wet with dew, and other portions partially wet with rain.

3. *How put in?*—Thrown in with a fork, then shaken out, in order as far as possible to maintain a level surface; and the grass well trodden down.

4. *How much put in at each filling.*—Two feet depth, when trodden solid.

5. *Use of the weighting apparatus.*—After each filling, the planks and weights were put on with the greatest care.

6. *Kind of weights.*—The weights were the same throughout the whole operation—viz., wooden boxes, 12in. square and 15in. high. They were filled with puddled clay, and weighed 100lb. each. The boxes are placed close together, and always so as to cover the junctions of planks, but without any idea of their excluding air by overlapping or otherwise.

7. *Covering boards.*—One inch and a quarter thick; their length equals the breadth of silo.

8. *Straw between planks and grass.*—No straw or any other material was placed between the grass and the covering planks.

9. *How long between each filling.*—Three days, with the weights on.

10. *Amount of sinkage.*—Not yet exactly ascertained, but probably a little more than one-half; or, in other words, 14ft. was put in, and the depth of the ensilage now is 6ft. 4in.

11. *Foreign substances mixed with grass.*—From 14lb. to 16lb. of common salt was supplied to each filling, but no other substance of any kind was added to the grass. Whether the salt is actually necessary remains to be seen: and next year one silo will be filled without it.

12. *If airtight and how?*—No means other than the weighting apparatus were used to make the silo airtight; nor was any attempt made in any way to hermetically close it.

13. *How is air excluded?*—By compression only.

14. *Heating.*—Not the slightest appearance of heating has been at any time observable in the mass.

15. *Chopping of material.*—This was dispensed with, because it would save labour and implements, and was considered unnecessary. We cannot think that any loss of space is occasioned thereby.

16. *How long closed?*—The silo was closed for two months and eleven days.

17. *Colour of ensilage.*—The colour of ensilage when taken out of silo was a "pale yellow green."

18. *How much removed at once?*—Just sufficient for a day's consumption is taken out of the silo at once, and no change of colour or smell has been noticed, even after being exposed for three or four days.

19. *How left after cutting?*—The silo is cut into for each supply, and the cut face left as you would that of a haystack.

20. *Quantity of grass put in.*—About fourteen cartloads—that is, two at each filling.

21. *What quality of grass should be used, and at what stage of growth should it be cut?*—From experience here, we say, "The better quality the grass, the better the ensilage;" and, as the aftermath portion has come out as good as the other, it should follow that grass of any age may be successfully used.

22. *Other crops.*—My neighbour intends to operate (in a second silo) next year, on tares, oats, and prickly comfrey.

23. *Material for building silo.*—The walls (14in. thick) of silo are built with good bricks and mortar, and faced with a coating of cement. The floor is made of bricks covered with cement.

24. *Is the silo sunk or not?*—The silo here is 8ft. deep, 7ft. of which are below the surface of the ground. Our experience has, however, suggested several important improvements, a description of which, to be clearly understood, should be accompanied with plans to illustrate.

25. *How drained?*—The silo was well drained all round, and under, but not "into."

26. *Should floor be level?*—Give it a fall of 1in. for its whole length, and at one corner of lowest end make a small shallow well, 9in. square by 3in. deep, from the bottom of which take a small pipe to a tap outside.

27. *How covered in?*—With a simple roof resting on the silo walls.

28. *Cost of construction.*—This can be easily ascertained, and would depend to some extent on local circumstances. There would be so many cubic yards of excavating, so many yards of brickwork and cement plastering, and lastly, a plain substantial roof of some kind. It has been determined that the next silo erected here shall be roofed over, and an arrangement made whereby the weights can be raised and lowered with a block and pulley, so as to ease the manual labour. An improvement in the weights is also contemplated.

29. *Cost of filling.*—This will depend very much on how far the land on which the grass grows is from the silo. After this it is only a matter of carting to the silo and filling in as mentioned under heads 2, 3, 4.

30. *Ration for each cow.*—From 35lb. to 50lb. per day, according to size of beast and quantity of other food given.

31. *Quality of butter and cream, and condition of cattle.*—The butter and cream continue of the very best quality, while the improvement in the general appearance of cows is most decided.

32. *Utility of silo.*—It is obvious that silos virtually perform at once the functions of the three existing operations—viz., first, hay-drying; secondly, stacking; and thirdly, that of a stacking barn. Moreover, they will, when fairly well built, last fifty years or more; so that, practically, no future expense need be incurred beyond that of filling them annually.

33. *Analysis.*—This is beyond my province, but I shall be glad to forward a sample to Professor Voelcker or any other analytical chemist for analysis.

34. *Weight of ensilage.*—One cubic foot was put on a scale, and it weighed 43½lb., thus showing that our silo contained, when opened, rather over 10 tons. Comparing this with head No. 20 shows that little or no loss of weight can have taken place under the operation.

There can be no doubt of the great importance of this subject to every agriculturist, more especially to grass farmers. One of my correspondents in Ireland says that he and his father had 300 acres of meadow to save last summer; and, owing to the extraordinary wetness of the season, a great portion was lost. To such gentlemen silos will be the greatest boon imaginable. They can cart to them all the grass from shady and damp places round woods, &c., leaving that on the more open and upland places to be made into hay.

Being urged by some friends to offer my services in connection with this question as far as my duties here will permit, I shall be glad to arrange for furnishing plans and particulars for silos, and also to give instructions and personal superintendence when required.

THOS. EASDALE.

Estate Office, Pepper Arden Hall, East Cowton, Northallerton.

Since the foregoing particulars were published, Mr. Copley has considerably added to and altered his silo, as will be seen by comparing the plan given on page 202 with that of the improved structure shown in the chapter on Silos, in the early part of the volume. A second and larger pit has been made and a new roof erected, extending 3ft. beyond the edge of the pits on each side, thus forming a bench or platform whereon the weights can be placed when taken off the ensilage; and at other times the space is found convenient for various purposes. One side and the two ends are enclosed with feather-edged boards, and at the front are double doors made of the same material; so that the building besides acting as a roof for the silos, forms an excellent store shed.

The small pit (the original silo) is 12ft. long, and the new one 15ft. long; both are 7ft. wide, and 10ft. in depth, 8ft. being below and 2ft. above the surface of the ground.

MR. STOBART'S SILOS AT PEPPER ARDEN, NORTH-ALLERTON, YORKSHIRE.

[The following contains the most material parts of several letters from Mr. Easdale which have appeared in the *Field* during the latter part of 1883 and the beginning of 1884. A plan of Mr. Stobart's double silo (which has been converted out of a large seldom-used building in a corner of the farmyard) is given in the chapter on silos in the earlier part of this volume.]

The large silo at this place—of 100 tons capacity—was opened on Oct. 22, and the improved "Cowton" silo on Nov. 10, and in both cases the contents were found to be in an excellent state of preservation.

We cannot any longer allow the question to be considered problematical as to whether "the thing can be done," since with us it is an accomplished fact in two successive years. Both at Cowton and here (within one mile of each other) can be seen ensilage chopped and unchopped—made of meadow grass, oats, clover and rye grass, tares, and prickly comfrey, and all well converted.

The silos at this place are each fitted with a small pipe, from their lowest part inside to a tap outside, for the purpose of drawing off whatever juice may have collected at the bottom. This juice is of the consistency of oil, and comes from the tap of a bright amber colour. It has been drawn regularly since the last week in September, and given to the pigs, mixed with their ordinary food. These animals have become so exceedingly fond of it, that some of them do not care to take their food unless they have with it their "gill of juice;" it has, moreover, proved of undoubted benefit to their general health and appearance. A litter of sucking pigs, immediately they were able to feed from a trough, took to this juice with avidity, and their attendant states positively that a skin irritation, which at the time troubled them, disappeared within a week, and they are now (Nov. 17) the picture of health, and doing well.

The entire cost connected with the work this year has been carefully calculated, and we find that the labour portion (including weighting operations) will not exceed 3*s.* per ton; the charge on the cost of adapting the building, 6*d.* per ton; and the charge on the cost of iron weights, 9*d.* per ton; making the whole cost per ton to be not more than 4*s.* 3*d.*

We cannot speak too highly of the convenience and adaptability of the iron weights that are used to obtain the compressive power. They were cast to a model specially designed by ourselves with a view to secure even pressure throughout the entire surface and convenience of handling, both of which objects have been obtained to the entire satisfaction of the owners.

Mr. Stobart's large pit (27½ft. long and 11½ft. wide) is being pressed with twenty-four tons of iron weights. With the assistance of three

men and our patent hoist, we lifted these 480 blocks a height of ten feet, and packed them away carefully in three hours and a quarter; and after a day's filling, these same blocks were removed from their places, lowered a depth of six feet, and placed in position in one hour and five minutes. In other words, each ton was raised in eight minutes, and lowered in two and a half minutes.

Mr. Stobart, having taken a great practical interest in the question, was anxious to obtain, by experiment, a trustworthy test of the value of ensilage as food for fatting cattle. For this purpose, twelve beasts were taken (eight steers, two cows, and two heifers); four steers and two cows were placed on one side, and four steers and two heifers on the other side. All alike were given the same quantity of meal and cake: *plus* this, one lot received daily for each beast 24½lb. of best quality hay and 95lb. of turnips, while each beast on the other side received, besides meal and cake, 75lb. of ensilage. No other food than what is mentioned was given. This diet was commenced on Nov. 10, and on the 17th the cattle were weighed separately. They were again weighed on Dec. 8 with the following result:

HAY AND TURNIPS.

No.	Nov. 17. cwt.	qr.	lb.	Dec. 8. cwt.	qr.	lb.	Advance. cwt.	qr.	lb.
1. Steer	10	0	0	11	0	0	1	0	0
2. ,,	9	3	0	10	2	14	0	3	14
3. ,,	9	1	0	9	3	7	0	2	7
4. ,,	7	1	0	8	0	0	0	3	0
5. Cow	11	0	0	11	2	14	0	2	14
6. ,,	11	3	0	12	1	0	0	2	0
Total	59	0	0	63	1	7	4	1	7

ENSILAGE.

No.	Nov. 17. cwt.	qr.	lb.	Dec. 8. cwt.	qr.	lb.	Advance. cwt.	qr.	lb.
1. Steer	12	2	0	13	2	0	1	0	0
2. ,,	12	0	0	12	3	7	0	3	7
3. ,,	10	2	14	11	2	7	0	3	21
4. ,,	11	1	7	12	0	14	0	3	7
5. Heifer	10	0	0	10	2	7	0	2	7
6. ,,	9	2	7	10	0	21	0	2	14
Total	66	0	0	70	3	0	4	3	0

Showing a balance of 49lb. in favour of ensilage. It will thus be seen that ensilage can supply the place of both hay and turnips, and have a considerable something to spare. The cows and heifers did not do so well as the steers; this may be accounted for in the fact that the cows 5 and 6 in the first lot were already well up in condition, and, being older, would not lay on so fast as the young animals. The heifer 5 in the second lot was suffering from a cold when housed, and has been dosep with medicine several times since; while her mate No. 6 has all along partly refused to eat her oilcake.

Thirty-six stalled and sixty-seven lean cattle are getting ensilage as a portion of their food every day, and it is calculated that the two pits hold sufficient to last, at the same rate of consumption, until the middle of April.

The experience of others as well as ourselves shows conclusively that, besides meadow grass, clover and rye grass, tares and oats by this method of preservation make excellent cattle food. That being so, I would take the liberty to call the earnest attention of all owners and occupiers of heavy or clay land to the subject. Let them take note of the experiment recorded in this letter, and let them feel assured that every one of them (unless their land is rotten with water, and consists of nothing but barren clay to the very surface) can grow in abundance the same kind of material, and quite as good, as that by which these results were obtained.

Mr. Stobart's flock of Cheviot in-lamb ewes have been getting a small daily allowance of ensilage since the middle of November, the object aimed at being to get the animals used to the new food before the severe weather set in or the lambing season came about. So far, the effect on the sheep has been most excellent, their health being everything that could be wished, with bright eyes and springy gait, and that nervous alertness so indicative of vigour. They will not touch the hay in the racks above so long as there is any ensilage in the troughs below. It may be added that a small quantity of oats is mixed with the ensilage, in the proportion of 10lb. of the former to 60lb. of the latter.

A letter has been received from Mr. John Nettleton, of Northallerton, the veterinary surgeon who has professional charge of the entire collection of Mr. Stobart's live stock, and he says, under date of Feb. 4, 1884:— "I am happy to say we have had far less disease amongst the cattle at Pepper Arden since they have been fed on ensilage than at any time previously whilst they have been under my charge; in fact, we have not had a single case of indigestion, constipation, or any disease that could be attributed to feeding—which is very remarkable, considering the large number of stock."

The many comments made on the subject of compressing ensilage since Mr. Jenkins's visit to the "silos of the north" show that considerable interest has been excited in connection therewith; and as the "iron blocks" so frequently referred to originated here, you will perhaps allow me to offer a few remarks illustrative of their practical application. These weights are reported as "huge blocks;" but, seeing that each of them contain no more than the merest fraction above one quarter of a cubic foot, I venture to think the term "huge" is calculated to convey an exaggerated idea of their size. Their dimensions are 18in. long by 5in. deep and 5in. broad, and they are as nearly as possible 1cwt. each. This weight does not exceed that of pig iron bars, which, as is well known, are handled by thousands of men daily, monthly, and yearly without complaint; whereas in silo work these blocks need not be raised and lowered on more than six separate occasions in any one season. Note

also that one layer of them (not two as reported) gives the desired pressure.

The manual labour, moreover, is with us much diminished by the use of the excellent patent hoist, which is peculiarly well adapted for the work; in fact, the assistance of this hoist is essential. It is to be feared, however, that those practitioners who complain of excessive clumsiness and laboriousness in the matter should really, in some degree, blame themselves for a want of foresight in not providing suitable convenience. All those gentlemen who have visited the silos at Cowton and Pepper Arden will have noticed that a bench or platform is provided at one or both sides of the pits, on which all weights rest while filling operations are being carried on, so that when wanted they are close to that part of the pit on which they are to be laid, and, with the hoist mentioned above, they can be lifted and laid with comparative ease. The result of this arrangement here is that the entire labour of moving the weights off and on the large pit (holding from eighty-five to ninety tons of ensilage) did not cost Mr. Stobart more than 30*s.* from first to last.

Under the searching examination of Mr. Jenkins and other gentlemen who accompanied him, it was satisfactorily proved that the cost of Mr. Stobart's ensilage when ready for feeding, and inclusive of rent and taxes and every other charge against it, did not exceed 14*s.* per ton, and that its feeding value was from 35*s.* to 40*s.* per ton. Considering this in conjunction with the other generally admitted fact that the quality of the ensilage here is second to none in the country, it may, I think, be reasonably claimed that the method by which this end was obtained has been fairly successful. THOS. EASDALE.

Pepper Arden, Northallerton.

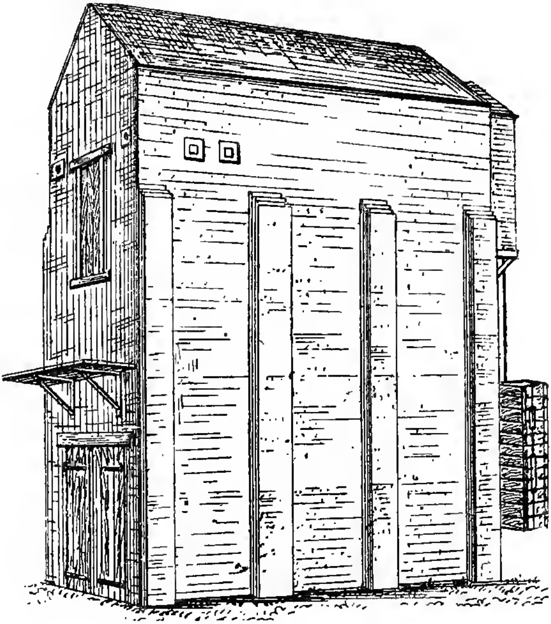
MR. C. G. JOHNSON'S LEVER-PRESSURE SILO.

THE building is of brick, all above ground, with slated roof. It is 28ft. high up to the eaves, 10ft. by 18ft. inside, 9in. walls, with the exception of the front end, around doorway, which is 14in. work; and is designed to be filled to 22ft. high of ensilage, leaving the remainder for working room.

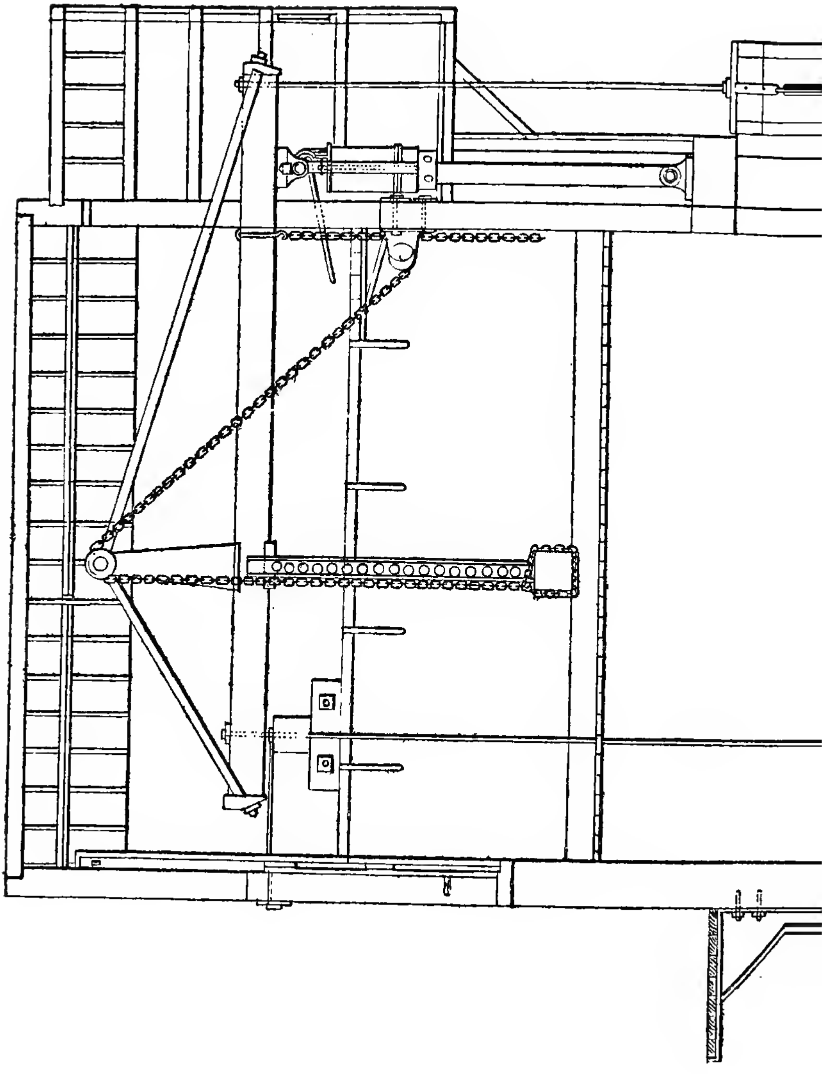
I began to build about the 1st of September, and the fodder intended to be saved (second crop seeds and clover) must be all in before, say, the second week in October, consequently there was no time for lime to dry; and being ignorant also as to the amount of lateral pressure to be expected from within, I thought it safer to have the walls up to 22ft. from the ground set in cement. Experience proved there was no lateral pressure observable. My next silo will therefore be either sheet iron, wood, or 9in. brickwork set in lime.

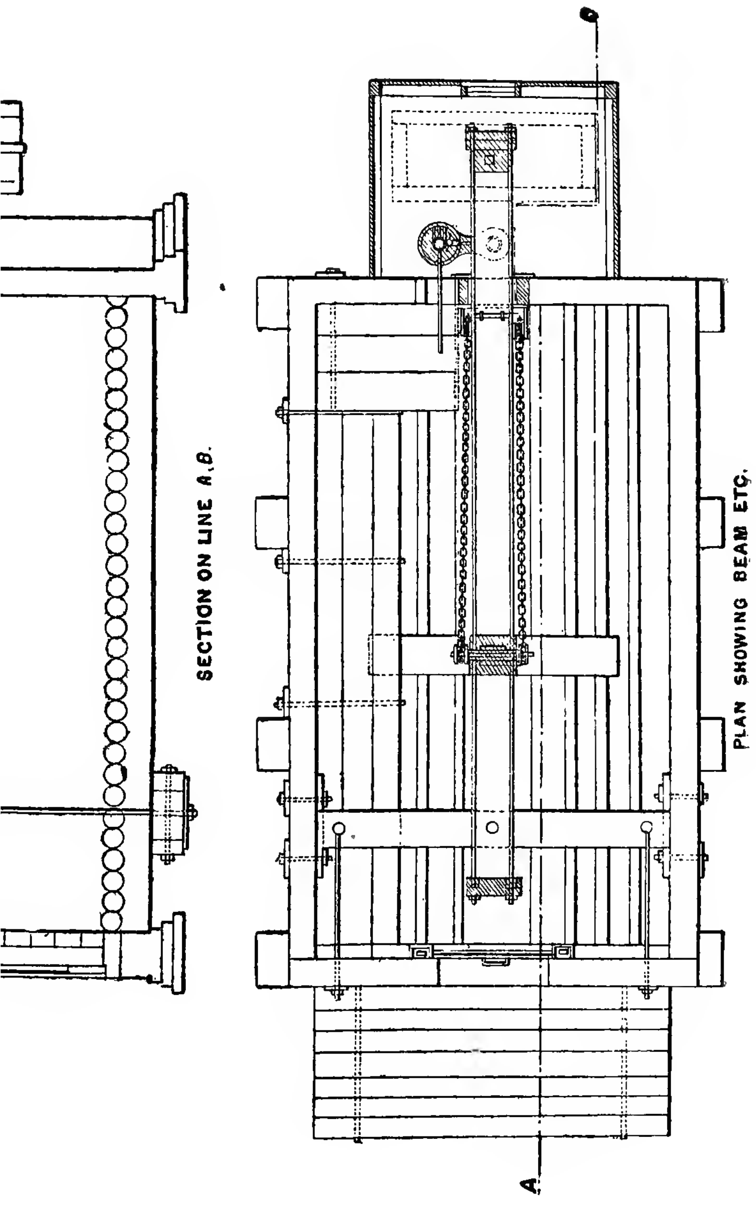
The bottom of the silo consists of a framework of rough wood, upon which the ensilage rests, and which, taken hold of by two rods communicating with one end of the lever-beam, enables the weight of the ensilage to be used as the fulcrum from which to inflict the pressure upon itself—thereby giving it a double squeeze from both top and bottom, and saving the necessity of heavy masonry, which would otherwise have to be provided to keep down the short end of the lever.

The crop is at first thrown in through the large folding doors at the bottom, which are made wide enough to admit a cart to back into the silo



to remove the ensilage. As the grass rises, this space is made up by loose boards (in my case old railway sleepers), one on the other edgeways. When it has risen above this aperture, it is forked off the cart by one man on to a scaffold, and from thence by one man standing thereon through the long-shaped window, which, as the grass rises, is also made up with loose boards as before described—the latter being in this case to save unnecessary forking until the stack has risen. I may here mention that, though I did not fill up the interstices between the boards (which I could easily have done), the ensilage was just as free from mould as at any other part of the wall sides; and further, it may be mentioned that




SECTION ON LINE A.B.
PLAN SHOWING BEAM ETC.
A

when the pressure was first applied from above, the air could be heard hissing out through these spaces.

When the day's filling is complete, the top covering of boards is laid on with longitudinal and transverse timbers to receive the pressure; the hydraulic jack (which it may be seen is at the weighted end of the lever) then comes into play, and lowers the wrought iron cradle and transverse timbers, which are attached by chains to the lever beam on to the longitudinal timbers, and a strong round iron bolt is then adjusted into one of the holes in the cradle according to the height of the ensilage. The whole force of the weight of the boxes full of stones at the out end of the lever—which is about four and a half tons multiplied by the length of the lever—then comes on and inflicts a pressure of about 2 cwt. per square foot (including weight of beam, cradle, boards, and everything); this at once presses down the grass about two feet, which is the extent of travel the lever gives at the point of pressure. The hydraulic jack is then worked by one man or very easily by two, and, having a stroke of about six feet, quickly raises the weighted lever; the pin in the cradle is withdrawn, and put in so many holes higher, say two feet. On comes the pressure again, and this time, the grass having become so far solidified as to be able to bear the weight, the beam is kept up at, say, half stroke, and there hangs the weighted lever, preserving a continuous pressure of about sixteen tons resting upon the grass. Or, if the attendant is not satisfied, and has reason to fear that there is not sufficient travel left to allow for the sinking of the grass before he comes again next morning, he raises it again to full stroke; and it is found that this is ample to last well into the next day, and thus secure continuous pressure. Next morning we generally found the ensilage sunk about another foot; the lever is raised by one man in a few minutes, and the weight left hanging in such a position that it must sink about two feet before it need again be adjusted. This is not generally for some days; and shortly, as it becomes settled, need not be looked to for weeks.

It will be seen in the accompanying sketch that the cradle upon which the beam rests its pressure does not appear long enough to reach the grass when only a small first day's work may have been put in. This, however, is provided for, as, though not easily shown on so small a scale, it is made telescopic, and lengthens out to follow the ensilage. It will also be observed that the chains which are attached to the cradle and transverse timbers are carried over two pullies at top of beam, and thence, after passing through two snatch-blocks fastened to the wall, can be hooked on to the lever beam, and then, by working the jack through its full travel of 6ft., they are raised about 8ft. out of the way of the people treading the grass.

When it is desired to remove the ensilage for consumption, the hydraulic jack raises the cradle, boards are taken off as far as required, and the weight put on again—the cradle retiring towards the out-end of the lever as each section is cut. Thus the same uniform continuous

pressure is maintained, the weight on the cradle being reduced by the shortening of the leverage in proportion as the area to be pressed is diminished.

Near the top of the silo there is a shelf which is for the piling away of the covering boards, and for the man to stand on to work the jack.

I believe my silo when full holds 90 to 100 tons. The weight of a cubic foot of ensilage 6ft. from the bottom was 60lb.

Of course, the somewhat unusual height of the building is to save first cost, as the expense of pressure is the same for a high silo as a low one. Also, the deeper the ensilage, the more pressure from its own weight, and the more full days' work at filling—not so much time being lost in starting and stopping as is the case with the small fillings for so many toppings out. This, to my mind, more than compensates for the wages of the man who forks off the scaffold, or for an elevator, if the latter be preferred.

I prefer silos above ground because it saves excavating; and, after all, you cannot have less than 9in. work, and in most cases the earth would require more to keep it up. Again it is much cheaper to fork off a cart in the long days of summer than out of a deep hole every time you fodder the cattle in winter, as will be found when this new feed gets into the wholesale scale of every-day practice. Besides, there is the risk of water oozing through your cemented walls and making tea-leaves of the ensilage.

I may add that for the last two months I have been feeding sixteen bullocks and heifers of the largest size on nothing but ensilage and 6lb. daily of cake and meal; and the result is, I consider, at least a dead heat between them and similar bullocks on the same allowance of cake and meal, and turnips and hay *ad lib.*, instead of ensilage.

I hope to put up another silo of about 100 tons to be ready for the spring.

Like you, I at present do not believe in light pressure or no pressure. The weight of evidence goes to prove, the greater the pressure the better the ensilage—the limit being that point at which the juices begin to squeeze out. Up to that weight it pays in quality of product, and quantity stored in given space. C. G. JOHNSON.

Oakwood, Croft, Darlington, Jan. 18, 1884.

[Mr. Johnson subsequently informed us that the total cost, including roof, windows, covering boards, &c., was about 150*l.*; of which sum 65*l.* was for the masonry of the building, and 40*l.* for the pressing apparatus. "At this figure," he remarks, "I have no reason to be dissatisfied, as I believe it compares favourably with the cheapest construction on the dead weight principle, even where only stones are used for weighting." The weighting apparatus, however, would have cost more had an engineer been engaged to do the work, but Mr. Johnson employed men under his own supervision.—ED.]

MESSRS. BRODERICK'S SILOS, AT HAWES, N. YORKSHIRE.

(*Agricultural Gazette*, Feb. 12, 1883.)

THE following is an account of an experiment made by my brother and myself last summer, hoping thus to help in deciding the real value of the system. I had long looked for some discovery which should insure the farmer against the heavy losses sustained by the bad harvesting of forage crops consequent on our uncertain climate, and some ten or twelve years since I made some small experiments by hermetically sealing grass pressed into tins, but was discouraged by the condition in which it came out, and the bad smell given off, though I now find that it had some resemblance to ensilage. When I heard of M. Goffart's trials and success in France, and those of his followers in America, I determined to try it at once.

Last year (1882) the Earl of Wharncliffe kindly offered to build us a silo, and we came to the conclusion that the easiest and cheapest method would be to make it an existing stone barn. We selected rather an old one, and excavated the rock to about 6ft., in order to get sufficient depth for the pit. From the bottom of this excavation we built thin inner walls—excepting in the front, which was very bad and was rebuilt—filled with grout or thin mortar, our object being to get solid air and waterproof wall, and also straight and perpendicular ones, as the old ones were not so. We thus saved the expense of building an entirely new barn and roof, and cattle shed or lean-to which is attached. The walls are faced with cement, nd the floor is constructed by laying a thin cover of 2in. or 3in. of lime concrete coated with cement, and the whole white-washed two or three times with cement without sand. This is important, as it gives a very hard, smooth, waterproof surface.

The silo thus constructed would have been 29ft. long by 14ft. wide, but we thought it best to divide it, for convenience in filling, by a partition wall a foot wide—of course faced with cement on both sides. This gives us two pits, each 14ft. square by 15ft. deep.

On Aug. 12 (a dry day) we put in as it was mown, unchopped, a very heavy crop of natural meadow from about five acres of land. We had three or four men inside tramping and spreading the grass evenly; it however, filled both pits to the top. On this we placed some bad hay, and then weighted with about 30 tons of stone (equal to 12 or 13 cwt. per square yard) without boards or planks. Next morning it had sunk about 6ft., and went on sinking for about a fortnight. In about a week after filling it had begun to ferment, and was slightly warm, but never attained a high temperature.

We opened it in the beginning of January, and, except a few inches on the top, it is perfectly preserved quite to the wall sides and bottom, some near the wall sides being nearly as green as when put in. The bulk of it

is about the colour that slightly sweated hay would be if wetted. It is perfectly clear of mould, or any signs of putrefaction, and quite cold; but if lightened and exposed long to the air, will again begin to ferment and heat. Thus, if the weight is taken off the edge where it has been cut away from, it will begin to heat and smell like sweating hay, and the cattle seem to like it well when warm; but it will shortly begin to dry, and mould.

We are feeding it to seven cows which calve early in the spring, and are therefore naturally fast losing their milk; yet they improved considerably for three weeks after coming from hay. The milk has a slightly altered flavour from that of hay; but the butter is very good in flavour and colour, much better than hay butter. The cattle are extremely fond of it, and this is a good test of its quality. They all ate it without hesitation from the first. Horses will generally eat it at once, and sheep after a short time. I think it at any rate equal to, if not better than, the best hay, though I should certainly hesitate to say that it is as good as green grass.

With our ordinary horses, hands, and machinery, we put in silos about five acres of heavy grass, and did some haymaking as well in a day. The rest of our hay, about 100 acres, took us five weeks, and a lot of it got spoiled into the bargain, though last hay harvest time was considered better than an average. At the rate of ensilage we should have done in less than three weeks, as most of our land had much lighter crops. Other things equal, the saving of labour, and loss by bad weather would certainly be a very great saving in favour of ensilage.

I do not think it at all necessary for the silos to be entirely sunk in the ground; and they would be quite as effective if entirely out of it, if strongly built and cemented. Nor is any concrete necessary; and I should say that nothing would make a better floor than bricks paved in mortar and coated with cement; stone or flags would also do. A great advantage may be gained for filling them by building them in hill sides, so as to bring the top level with the ground at the back side, and it also affords fall for drainage of the walls. Many existing stone barns can be converted into silos by simply cementing the walls and laying down floors.

It is also quite unnecessary to chop grass for ensilage; a little more pressure will do just as well. The object of chopping is only to make it pack closer, or, in the case of maize, to make it more eatable.

Hawes, North Yorkshire, Feb., 1883. GEO. BRODERICK.

Since I wrote on the subject of ensilage last year, my brothers and I have had two more barns converted into silos, and we thus have had this year the experience of four silos, with an estimated weight of between 200 and 300 tons of grass.

Through having existing barns, the investment has been small in comparison with those who have built entirely new silos; yet the result may

be interesting to those who, like ourselves, have stone or other barns, and may think of converting them. The two we had made in 1882, with a capacity to hold about 150 tons, cost about 50*l.*; the second one, capable of holding about 70 tons, about 20*l.*; and a third one, with a similar capacity, about 10*l.*

I believe many of the experimental silos I have seen have been made to cost a great deal more than necessary, through want of a proper knowledge of what was really required. This is necessarily the case with anything in an experimental stage, and therefore any estimates of costs, whether of building silos or filling them, at present made, though very instructive and useful, ought not to be regarded as correctly representing the cost of the system when the experience of a few more years may have brought it much nearer perfection.

There seems to be the most room for improvement in the methods of weighting, and for experiment on the amount of weight, or other manner of compression, required to obtain the best result. The latter point is of special importance, but does not seem yet to have been satisfactorily solved. It would make a considerable difference in the cost of filling if it were found that a comparatively light weight will make as good ensilage as a heavy one. There have been various methods of mechanical pressure tried with varying success, but we have as yet mainly used stone, iron, and other manufactured dead weights, costing, in some cases, as much as the silo itself, being far too costly for general use. A great point is to have the silo deep, since the same weight presses a quantity of ensilage varying in proportion to the depth. One hears of silos from 7ft. to 12ft. deep, with lateral dimensions of perhaps 17ft. by 40ft. This is altogether out of proportion, and would take three times as much weighting as one, say, 15ft. by 20ft. by 25ft. deep, which would hold more ensilage and would have far less waste on the top and sides. Of course a good deal depends on the nature of the ground as to the depth they can conveniently be made. If a steep hillside can be taken advantage of, a silo can easily be made 30ft. deep.

It is stated by some that the weights should be put on every night whilst filling; but this entails a lot of labour, especially where the process is slow; and we have not found it at all necessary. If grass be filled in to a depth of 8ft. or 10ft. one day, it will not take any harm before next morning, when the filling can be recommenced, and another depth of 8ft. or 10ft. put in—which is sufficiently heavy to press that previously put in; and so on till the pit is full. Of course, if the filling is interrupted for more than a day, the weights will have to be put on. When the weights are put on, a great shrinkage takes place, making room for more fodder. But where dead weights are used, it seems questionable whether it would not be cheaper in the end to make the silo large enough to hold the whole crop at one filling and weighting, saving the labour of handling the weights so often. It may look an easy matter enough to people experimenting with 10 or 20 tons of ensilage in a small silo to toss a few tons

of weights on and off half a dozen times; but in practice, where 200 or 300 acres have to be siloed, it would become a serious matter.

The best shape for a silo, I fancy, is long, or oval, with the door for emptying at one end, so that the least amount of surface will be exposed while cutting away. It is often stated that exposure to the air does not affect the cut face of the ensilage; but if anyone will take the pains to cut a slice 2in. thick from a face that has been exposed a few weeks, and perhaps become mouldy, he will find that it has become darker coloured and of an insipid smell, showing a considerable deterioration in quality.

To save the expense and trouble of having a mason to wall up and cement the doorways each year, we have had loose wooden doors made, which fit the doorways, and are placed flush with the cemented wall inside. They are then supported behind by two upright doorposts, which are held firmly in their places by wedging top and bottom pieces tightly in between them. The crevice left between the door and the cement is then plastered up with cement or good clay. All that is required to open the door is to strike out the top and bottom pieces from between the upright doorposts, and the whole thing will come out. It is not necessary that the doors should be so very strongly fixed, as there is practically no lateral pressure in ensilage [when the grass is not chaffed. —Ed.]

It is not necessary to chaff the finer grasses for ensilage, but those who have power and machinery may do so if they choose.

We have pitted grass in dry weather when it was free from external moisture, and also when it was dripping wet, with no material difference in the preservation resulting, except that when it is put in wet there is more soakage at the bottom—which should not be wasted—and less heating during fermentation. With ordinary grass I think it is better to err on the wet side, if either. If it is allowed to dry in the sun for a few hours, the heating in the silo will be much greater.

The cost of storing green crops may be anywhere between ten and twenty shillings per acre, according to crop and circumstances; but, on the whole, I am inclined to think it is cheaper than making hay. The question of emancipation from the effects of the weather in securing forage crops, which has so long exercised men's minds, has been absolutely solved by this system: and this, I dare say, is its main advantage, though I think it has others.

Meadow grass will lose from 75 to 80 per cent. of its weight by drying to hay.* How much it will lose by conversion to ensilage I cannot say, but it cannot be much, since by artificially drying ensilage I find that it loses over 75 per cent. of its weight. Now, I have been feeding milk

* The amount of water in grass varies considerably in different localities, and in North Yorkshire the percentage is evidently very high. We hear there of ensilage weighing from 58lb. to 60lb. per cubic foot; whereas, from drier parts of the kingdom, we have received samples weighing only about 30lb. per cubic foot, so little moisture did they contain.—Ed.

cows entirely on ensilage, and others of similar age and size entirely on hay, and I find that those on hay eat on an average 28lb. per day each, and those on ensilage eat 66lb. per day, and thrive better than those on hay. The 28lb. of hay on the above calculation represents 112lb. of grass, and the ensilage, I should think, at the outside, not more than 70lb., showing a gain of over 30 per cent. These figures are rather startling, but they seem to be fully borne out by the extra number of cows that will winter per acreage on ensilage.

It may seem incredible at first that the same material can produce such different results by different methods of preservation. But it should be remembered that the chemical analysis of a feeding stuff is not a true guide to its value as a food; for a succulent food is more readily assimilated than a dry one, and will therefore produce a better result, though it may not show a higher analysis. Also that, in the conversion to ensilage, certain woody substances are rendered more digestible; but, by a process of drying, they are rendered less so. Certain stimulants are also formed by fermentation, as alcohol, aldehyde, &c., which probably assist, to some extent, the process of digestion. If anyone will take notice of a grass crop mown before it is ripe, he will find that, during the few days that it is drying, a very rapid ripening process takes place, and probably a considerable portion of the nutrient constituents of the plant are converted into woody fibre, or transferred to the seeds, which, when the hay is dry, appear to be quite ripe, and in great part shake out. When all these things are taken into account, it becomes apparent that it may be quite possible for a difference of 30 per cent. to exist in the value of the two products.

Some chemists will tell us that, by the conversion of grass into good hay, practically all the nutritious substances are preserved. But the practical farmer knows that a very considerable part of the feeding value is lost. It is not difficult to prepare cattle for the butcher on a good pasture without the assistance of any artificial food. But who would think of doing so on hay, even on the very best quality? And it is only necessary to look at the difference of the milk yield and the quality of butter, between hay and grass feeding, to convince one whether grass loses value by desiccation. This settled, it follows that, if ensilage is a nearer approach to grass than hay, it is of more value per acre; and this it evidently is, though it is far from proved that it is equal to green grass. Perhaps it approaches nearest to grass in the quantity and quality of milk and butter produced from it.

There are a few other minor points of advantage over hay. Along with being placed independent of the weather, one can cut the crop when in the best condition, which was not always the case by the old method. Being able to get the crop off the land at once, the aftermath, or second crop, can begin growing at once, without being interfered with, which it could not always do with hay. In fact, it is sometimes very seriously damaged by the hay being tossed about on it for perhaps a fortnight or

three weeks. Though I have not tried it, ensilage might be expected to be good for horses that have bad teeth or are broken-winded.

The most disagreeable feature about it is the smell, which, though not offensive, hangs about a good deal, and might not be pleasant about a homestead.

On the whole, however, we are so well satisfied with it that we shall probably build three or four more silos this year. There is a considerable outlay in the first place, and this will no doubt be a serious question with many tenant-farmers and others wishing to adopt the system. Our landlord, the Earl of Wharncliffe, very kindly built us those we have on his property; and it is probable that many landowners will be very willing to facilitate the adoption on their estates of a system which promises to be so very beneficial to the occupiers. It is, at any rate, a good investment, and one which will bear good interest; and I believe the land loan companies will now advance money for the building of silos.

Hawes, North Yorkshire, March 3, 1884. GEO. BRODERICK.

REV. C. H. FORD'S SILO, BISHOPTON, CO. DURHAM.

[As the cost of Mr. Ford's silo was considerably increased, owing to the troubles arising from its being built in gronnd liable to the invasion of water, we repeat the original estimate, for comparison with the statement of actual outlay.]

ESTIMATES for building a silo must vary, to a certain extent, in every locality, and must necessarily depend on the cheapness or dearness of materials. The land in this neighbourhood consists principally of strong clay, and ironworks exist where slag can be generally obtained gratis. I have obtained estimates which I think may be useful to those situated, as I am, within reach of such material.

The size I have fixed upon is 15ft. in length, 7ft. in width, and 8ft. in depth, but arranged in such a manner as to be able easily to double it if necessary. The contract price is as follows:

1. IF BUILT OF RUBBLE SLAG, SAND, AND CEMENT.	£	s.	d.
55½ cubic yards excavating, 1*s.* per yard	2	15	6
49 superficial yards of slag rubble, mortar composed of fine cement and ground slag provided by contractor, 2*s.* 6*d.* per yard	6	2	6
11⅔ floor, 10in. thick, 2*s.* per yard	1	3	4
50⅛ yards of skimming to walls and floor, with cement plaster, 8*d.*	1	13	5
105 square feet 2in. battens, to cover ensilage	1	15	0
Roof, including wall plates, 187 square feet, 6*d.* per foot	4	13	6
Concrete blocks for weighing ensilage, bolt and eye to each block, 12 tons weight	11	0	0
Patent block and sheave running on iron rail	5	0	0
Cartage of materials	6	0	0
	40	3	3
If excavating and carting be done by owner, less	8	15	0
Total	£31	8	3

2. If Built of Concrete Walls 15in. Thick, and Floor 12in. Thick.

	£	s.	d.
Concrete walls and floor	9	2	6
(The other charges the same)			
Total cost in concrete	£34	4	11

3. If Built in Brick.

	£	s.	d.
Excavating less quantity owing to thinner walls	2	3	0
62⅔ yards 9in. brickwork inside course, walled in cement, at 4*s.* 6*d.* per yard, including bricks	14	2	0
50 yards in cement plastering, at 6*d.*	1	5	0
Boards to cover ensilage, carrying weights	1	15	0
Roof	4	13	6
Concrete blocks	11	0	0
Sheave, patent block, and iron rail	5	0	0
Cartage	4	0	0
	43	18	6
Less excavating and cartage	6	3	0
Total	£37	15	6

That these prices are not imaginary, I may mention that the contractor will build a silo for any one at the price given above.

Having studied the difficulties of weighting, and the expense thereof, I have determined to make my weights of concrete. At the ironworks you can always get what are known here as "runners"—that is, where there is a large mixture of iron in the slag. These lumps are very heavy. I intend to put one or two of these into each square of concrete. I shall have each weight made about 5cwt. They will have an eye let in below the surface of concrete block so as not to protrude. Over the centre of the silo, say 6ft. high, I shall fix a common railway rail double the length of pit, on which will run a sheave, to which will be attached a patent block. Each weight, when raised above bank, will be run along iron plate on sheave clear of silo, and packed one on the top of another out of the way. The roof will rest on brick wall on the top of one side of silo, raised say 3ft., and will incline like a cucumber frame, so as to keep its water at a safe distance from silo. Chas. Henry Ford.

Bishopston Vicarage, Ferry Hill, Co. Durham, Jan. 27, 1883.

On the 3rd of April I commenced building a silo, 5ft. below ground, 4ft. above; soil, stiff and tenacious clay. Owing to interruption caused by sowing spring corn, the excavation was not completed until April 11. Depth, 6ft. 4in.; length, 18ft.; width, 12ft. 4in.; total cost, 1*l.* 15*s.* 3*d.* A field drain 4ft. deep was cut across; this was taken up and diverted; not a sign of water was visible—not even a dampness at 6ft. 4in.

April 17, began concreting the bottom of pit with 12in. of concrete. April 26, finished concreting wall, 15in. thick. April 30, mason came, and began walling on the top of concrete; finished walling May 3; roof

put on. May 4, fixed crane to lift weight; cemented inside of silo, 2in. on sides, 3in. on floor.

May 8, after a wet night, water spurted through the concrete floor 17in. thick. May 9, water standing several inches deep on floor; immediately set men to work to expose the walls of concrete below the foundation, and filled all round the outside walls with 2ft. well-puddled clay, at a cost of 2*l.* 18*s.* 6*d.*; re-cemented the floor with an additional 1½in. of cement. I hoped for the best, and that my troubles were now over. Futile hope! May 29, water again came in; so I determined to sink a well 6ft. below the foundations, on the N.E. angle of the silo; completed the well June 5, at a cost of 1*l.* 2*s.*, and drove a channel into and under the foundation of silo. This relieved the water supply, and diverted it into my well. No sign of water till June 28, when I was about to fill the pit with cut grass. Lo and behold! the water reappeared in small quantities; so at all hazards I determined to cure it. I therefore broke up the floor so as to admit a 2in. pipe, and made a drain communicating with the well right under the foundation, with a branch to each corner of pit, filled it with stones, and re-cemented it. July 2, the well was walled at a cost of 14*s.* for labour, and on the following day (July 3) water again reappeared. Perseverance is the motto of every Englishman; so I broke up floor under south and north end walls below the foundations and put in a 2in. drain, communicating with the drains already put in. This has cured it—at last.

Strange to say, my troubles were not yet over. I consoled myself with the thought that I had at any rate got a good supply of water for the cottage at my buildings, when, lo and behold, I find that the liquor from the ensilage has found its way through the cement into the drains, and so into the well, and makes it smell very unpleasantly. At any rate, my silo is dry.

Your readers will exclaim, "What a fool you were not to drain the pit first!" The configuration of the ground was such that I should have had to cut a drain 9ft. deep, through a field drained 4ft. deep, for 300 yards, before I could get an outlet, the drains of which would, of course, be injured; so I preferred the well as the least costly.

I engaged a professional concrete maker, and I think that there can be no mistake about the concrete being good. It consisted of seven contractor's barrows of broken slag and sand, both quite clean, and 2cwt. of best cement. No pains were spared to produce the very best article, and the man who made it is one of the most experienced practical working men in concrete work in this county.

On reviewing the cause of the water coming in, I am inclined to think that it arose thus: On April 18 the floor of silo was laid; on the following day the concrete walls were commenced. Did the concrete of the walls, and that of the floor, become homogeneous; or was there an interstice left? The hardness of the concrete was so great that it was only broken through with immense labour. Steel wedges, held by black-

smith's tongs, and driven by a sledge hammer, accompanied by a heavy iron bar, sharpened at the point, just chipped it away.

Owing to the invasion of water my silo has cost 10*l.* 4*s.* more than I estimated in your pages last spring; but it is a foot more in breadth and depth than I at first intended. It is now 15ft. by 8ft. and 9ft. deep.

	£.	*s.*	*d.*
Labour, including excavations, concrete, exposing walls, 2ft. puddled clay, sinking well 12ft., walling ditto, levelling, &c.	13	17	4
Crane and carriage	3	2	8
Sand	0	12	0
Mason	4	3	10
Felt for roof	1	5	7
Joiner	11	10	7
Cement, with carriage	10	15	8
Blacksmith ironwork	1	8	4
Pump, lead pipe, and fixing	2	13	3
Well bricks	0	18	0
Total	£50	7	3

I think it right to say that this sum does not include the services of my farm man and two carts and horses, nor any charge for superintendence.

I filled the silo on July 5, up to 9ft., with grass not cut into chaff. In three days the mass had sunk 4ft., having been loaded with 200lb. to square foot. July 12, filled it again with grass to the top, 9ft. On July 23 I reopened and refilled, and find that I have now 5ft. of ensilage. Filled up again to the top, and have now about 3ft., which will, I believe, hold at two cuttings and weightings my second crop of clover—a poor crop.

The cost of making ensilage I have found to be about 10*s.* an acre, I have kept a strict account of the men's time and the wages of each. I have used no salt and no chaff cutter; and, now that the men are getting accustomed to the work, the shifting 10 tons dead weight took exactly fifty minutes.

I calculate that I have put into my silo about twenty tons of fresh-cut grass and clover. It was not possible in my case to weigh it as it went in; and if two cubic yards of ensilage weighs a ton, I must have nineteen tons of ensilage, which Mr. Jenkins, secretary to the "Royal," pronounces to be a first-rate sample. CHAS. HENRY FORD.

Bishopton Vicarage, Ferryhill, Durham, Aug. 28, 1883.

From the 5th to the 13th of November I fed my three cows on grass in a good pasture, with the addition of hay, cotton cake, and pollard. The average produce for the above time was 11 quarts in the morning and 9 quarts in the evening. The quality, as ascertained by analysis on the 13th, was that of fair average country milk.

From Nov. 20 to Dec. 10 the cows were fed on hay, cotton cake, and about two stones of ensilage each daily. Ensilage was first offered to the cows on Nov. 13. One ate it from the first, the other two ate very little,

and it was not till the 20th that they could be said to eat it clean up without waste; so I calculate this experiment did not fairly begin till the 20th of November. The milk, to my astonishment, sank to 10 quarts in the morning, but still remained at 9 quarts in the evening. This may have been caused, first, by change of food; secondly, by the weather preventing their grazing in the pasture; but such was the fact. The butter made from their produce was excellent in colour and taste, with a marked improvement in both. The analysis showed also an improvement in fatty matter.

From Dec. 10 to Dec. 17 the cows were fed on ensilage and cake only. They ate as much as they chose, no waste being allowed. The quantity of milk was maintained, not increased, as I expected: the cream and butter were excellent, and the analysis showed an increase of fatty matter, and, not to use technical terms, the quality was improved.

From Dec. 17 to Dec. 31 the cows were fed on hay, mangolds, and cake, the mangolds as much as they could consume. The quantity of milk was still maintained, but the analysis showed an increase of one-fourth in the fat.

I may here state that my cows are bred by myself, and are useful, common country cows. I consider a severe test of the several experiments that one cow has calved twice (the last calf dropped on May 8), and the other two calved their first calves respectively on June 3 and Sept. 10. Consequently they might be expected to drop their milk very much at this time of the year.

The result of these experiences, to my mind, is to show that ensilage has not increased the quantity of milk as I expected, but that it has maintained the quantity given by two heifers during the depth of winter, and improved the quality of their produce at a period of the year when one might reasonably expect them to fail considerably.

It is to my mind very unusual to see cream, at this time of the year, so thick as to be clotted and to leave the cream jug with difficulty; and, if you calculate the cost of ensilage, it will show a favourable comparison with any other food whatever. My five calves, living on ensilage and hay only, are in remarkably good, healthy, and thriving condition; and the other animals, fed in a similar manner, are in a better condition than I had them on this clay glebe farm during twenty-five years' experience.

CHAS. HENRY FORD.

Bishopton Vicarage, Ferry Hill, Jan. 15, 1884.

MR. A. H. GRANT'S EXPERIENCES IN HAMPSHIRE.

[In the following article, Mr. Grant has supplemented the information contained in his letter published in the first edition of this book, by adding thereto the results of his experiences during the past season.]

Having read of the ensilage system, as practised in France and America, I thought that, as gooseberries are preserved in bottles of water, so grass under pressure in cemented tanks would practically be under water, on account of the quantity of water pressed out of it, and filling the space between each blade. This, I believe, is really what occurs in ensilage.

In the autumn of 1881 I ensilaged 4½ acres of hop clover and Italian rye grass. It was a miserable third cut, but it made capital fodder after preservation in a small experimental silo, 6ft. by 6½ft. by 6½ft. deep. I think it weighed about 6 tons.

Encouraged by this success, I ensilaged, in the summer of 1882, about 70 tons of meadow grass with perfect success; of this quantity, the produce of 5 acres was cut and carried in very heavy rain, purposely for experiment. This portion was perfectly preserved, but it came out of a much darker colour than that ensilaged in fine weather. The stock consumed it all, but I fancy they preferred the fine-weather sample.

I likewise pitted a few loads of Trifolium incarnatum. Some of this was carried in rain. The cattle ate it all, but it was put in my small pit and with insufficient weight upon it, and therefore was not as good as my other samples.

My pits are oblong, and of the following dimensions:

6ft.	by	6½ft.	by	6½ft. deep.
15	,,	11	,,	10 ,,
15	,,	11	,,	10 ,,
20	,,	15	,,	10 ,,
16	,,	15	,,	10 ,,

and I am building others which will be:

20ft.	by	15ft.	by	10ft. deep.
20	,,	15	,,	10 ,,
21	,,	18	,,	10 ,,
9	,,	9	,,	8 ,,

I prefer a depth of 10ft. to a greater or less depth; 10ft. gives depth sufficient to store a large quantity, and is not too great in depth for a man to pitch the grass out with a pitchfork. I also doubt if ensilage of a greater thickness is as good at bottom as higher up.

The various sizes are to suit the "mows" of old barns, &c.; and the two small silos are made out of disused liquid-manure tanks, and will chiefly be kept for experimental purposes.

My soil is gravel. This gravel is of considerable value when dug, and it requires only a very slight retaining wall, thus greatly reducing the cost of digging and building.

The walls which I put up are of 4½inch brickwork, run over very thickly with cement—cross walls between two pits are of 9in. work.

The roof is of corrugated iron, built in one case as a lean-to to the cow-house wall; a door leads into the feeding passage in front of the cow-stalls. Two of my pits are roofed with "Willesden" paper roofing, but I do not care about it—it is perfectly water tight, but in filling a silo men are apt to strike the roof with their prongs, and the paper, of course, will not stand rough treatment. Two of my new pits will be placed under the thatched roof of a barn.

My weights are chiefly rectangular blocks of concrete, 9in. by 9in. by 18in. (but 8in. by 8in. by 12in. would be more handy). Mine weigh from about 100lb. to 120lb. each. Before commencing to fill a pit I build the blocks all round on the top of the walls to a height of, say, 3ft., so that I get that much additional pit-room at merely the cost of the time and trouble spent in stacking the blocks.

I then fill the pit as fast as possible with fresh-cut grass to the top of this temporary wall. My pit is 10ft. deep; the temporary wall 3ft. I thus get a depth of 13ft. I then lay on a few planks and some weights, say 30lb., to the superficial foot, but merely thrown on as quickly as possible. Next morning I find the grass will have sunk about 4ft. I again fill to the top of my temporary wall, but securing a total depth of grass altogether of, say, 17ft.

I now place on the top of the grass about 3 inches of fern, straw, hedge-row trimmings, &c., &c. The surface is sure to decompose, and you may as well lose refuse as good fodder. On this refuse I place 2-inch boards, each as long as the pit is broad. This use is merely to give the weights a level bearing. I carefully place a row or two of weights all round the outside of the boards, and throw on earth, iron, stones, and anything to make weight. The mass at once begins to sink, and as soon as the surface of the weights sinks below a tier of blocks in my temporary wall I roll that tier on to the boards as additional weight, and so on until I have about 150lb. to 200lb., and in the corners 300lb., to the superficial foot. The 17ft. of grass will sink to about 7ft.

In perhaps two months, if I have a later cut of grass to ensilage, I remove the weights and boards and proceed as before, getting in as much as possible.

In cutting out the fodder, I remove, say, a width of 2ft. of boards and weights, and then proceed to cut a vertical slice from top to bottom, as in a hayrick, and with a hay knife. The surface of a cut will keep sound about a fortnight, but this depends somewhat on the amount of weight used, and consequent solidity.

I will again borrow Mr. Easdale's tabular arrangement of questions and answers.

1. *Kind of grass.*—I have ensilaged (1) hop clover and Italian rye-grass; (2) meadow grass; (3) trifolium incarnatum; (4) spring vetches and oats. I have now growing, for 1884 ensilage, hop clover and Italian

rye, common rye, winter vetches, and oats, and I shall probably try green buckwheat. Spring vetches and oats make perfect ensilage, but I prefer Italian rye-grass, either with or without hop clover, to anything else. I believe that anything green will make ensilage. (See also remarks about maize in No. 15.)

2. *State of grass when put in pits.*—Generally dry, but some very wet. I prefer it dry.

3, 4. *How put in and how much at once.*—I tip the carts and let the grass fall into the pits, carrying as much as I possibly can in the day, and treading it well, especially close to the walls and in the corners.

5. *Use of weights.*—I put on some whenever I stop work, and, when the pit is full, as much weight as possible. I think I can scarcely have too much.

6. *Kind of weight.*—Concrete blocks 9in. by 9in. by 18in., also earth, sand, both loose and in boxes, old iron, paving stones, bricks, &c. For the future I shall make my weights 8in. by 8in. by 12in. They will be handier.

7. *Covering boards.*—Common deals or Scotch firs 2in. thick; in length they equal the breadth of the pit. The moisture from the ensilage very soon destroys these boards. I think they will not last above three seasons. I shall therefore split with a steam saw a number of small Scotch firs, of the size one generally sells for pit-props; these will be cheaper than boards.

8. *Straw between grass and boards.*—As above stated, I think some straw saves some fodder, as the surface is sure to become mouldy.

9. *How long between each filling?*—Immaterial, if the weights are on.

10. *Amount of sinkage.*—Very great—nearly two-thirds.

11. *Foreign substances.*—I have tried bran, but I thought it useless. It came out apparently the same as when mixed with the grass, though, of course, wet. I now mix nothing at all with the grass. I have tried sprinkling the ensilage with salt, after cutting it out from the pit and shaking it up, but without any apparent effect on the cattle. My cattle, however, always have a lump of rock salt in each manger.

12, 13. *If airtight and how is air excluded?*—There is nothing to make the pit airtight, except compression by the weights.

14. *Heating.*—None observable, but there must be a little at first, as there undoubtedly is fermentation—probably before the compression is complete.

15. *Chopping of material.*—Chaff-cutting is certainly unnecessary, and therefore a useless expense, with all the grasses, &c., which I have mentioned above. It is probably necessary with maize and other woody foods, from which the generality of American and French ensilage has been made. Even in the mild climate of Hampshire I cannot make maize a success. On wonderfully rich and carefully-worked soil, saturated with manure, I have grown maize seven feet high, and with very thick strong stems, but the first heavy wind from the south-west blew it all down, and

in the fields it grew fairly well, say five feet high, and very thick, but the same fate overtook it. A neighbour of mine tried it in a fairly good field, but it was useless as a crop. I may mention that my seed was specially sent over from America by Mr. John M. Bailey, of Massachusetts and Virginia, U.S.A., one of the earliest ensilagists, if not the earliest, in the States.

16. *How long closed?*—Various times—from two months to eight months.

12. *Colour.*—Pale yellowish green; that carried in rain is dark greenish brown, almost black. The flowers of hop clover remain bright yellow; the red of Trifolium incarnatum turns dark purple. The smell is much like that of a brewhouse, and will cling to one's boots, clothes, hands, &c.

18. *How much removed at once?*—When I had only a few cows I cut enough for, say, three days' use; now, with a large herd, I cut every day, except Sunday.

19. *How left after cutting?*—Just like a hayrick.

20. *Quantity of grass put in.*—I cut and carry as fast as possible.

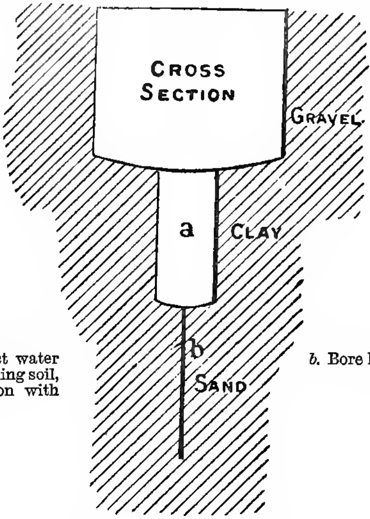
21. *Quality of grass.*—I have always had a very good quality of grass, as I cut it when very young (even for hay), long before it begins to get woody.

23. *Construction and material of buildings.*—Four and a half inch brickwork, and, for very small silos, bricks set on edge, run over with very thin cement. The floor must be strong, to prevent, as happens in some soils, an accumulation of water beneath the floor, which, exerting an upward thrust, bursts the floor and floods the silo. I have had this happen in two silos, to the great detriment of the water-logged ensilage. To prevent this, I now brick the floor of my silos, dishing them so as to form an inverted arch, and I lay these bricks in mortar, "grouting" them in with cement.

24. *Is the silo sunk?*—Mine are altogether beneath the level of the ground, for convenience in tipping the grass out of the carts.

25. *I have no drainage at all.*—It is, I think, essential to keep outside water out, and to keep the *natural moisture of the grass in.* These points and *heavy weights* are, I think, the three essentials to really good ensilage. Ensilage which cattle, especially dry cattle, will eat, may be made without attending to these points; but the best ensilage to make really high-class butter, and plenty of it, cannot, in my opinion, be made without the greatest care in these three particulars. I particularly draw the reader's attention to this point, as in my letter published in the first edition of the "Silos for Preserving British Fodder Crops" (published in 1883), I said, "I should drain into a dead well if the nature of the soil permitted." I meant to have said, "I should drain the soil surrounding and outside of the walls of the silo into a dead well, if the nature of the soil permitted." On reading over the proofs of my letter I carelessly overlooked this omission, which I afterwards noticed when writing a later

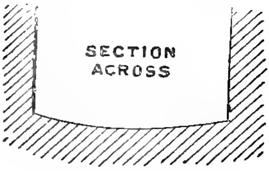
letter to *The Field.* I am draining the ground surrounding a new silo as in the annexed drawing, this, of course, only suits particular localities.

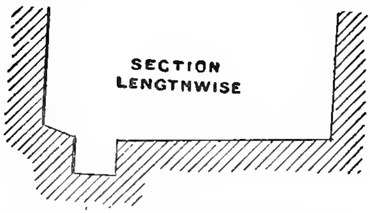


a. Dead well, to collect water from the surrounding soil, with no connection with the silo.

b. Bore hole into the sand under the gravel.

26. *Should the floor be level?*—I now make tho floors of my silos dished to give the strength of an inverted arch in case of water collecting beneath, and I give them a slight run towards one end; and I make a small dipping place near that end, as shown in the section lengthwise. I find that a certain amount of ooze comes out of the ensilage, and if it is collected in a dipping place it will save some incon-





venience to the men who cut the ensilage. Otherwise the portions of the fodder which fall to the floor in the process of cutting out get very moist, and then the men's clothes become wet in throwing the grass out of the pit with the fork. 18 inches deep by 20 inches square is quite large enough for this dipping place; in fact, it should be just large enough to receive a bucket.

27. *How covered in?*—I prefer corrugated iron.

28. *Cost of construction.*—I do not know how much my silos cost, as the men were continually taken off for other work; and the cost much depends on the local price of labour, the nature of the soil, and the thickness of the wall necessary to retain the soil. I am now making a silo in a barn. I shall not therefore have to charge for the cost of a roof, as the barn, when the silo is filled, will be just as useful for storage of corn, &c., as before. The gravel which I have dug out (about 5*l.* worth) just balances the cost of digging. It has beeu used for roads, &c., and some of it, being of very good quality, for garden purposes. The silo will be about 21ft. long by 16ft. wide by 10ft. deep—of which depth 7ft. will be excavated, 3ft. filled up to the level of the old barn floor. Bricks and bricklayer's labour, cement, and lime, will cost about 15*l.*, and weights perhaps 8*l.* more; rough fir slabs 2*l.* I thus get a large silo complete for 25*l.*; but this cheap construction can only be obtained under very favourable circumstances.

29. *Cost of filling.*—I cut and carried in 1881 five acres at 7*s.* 2*d.* per acre. In such a season as 1881 was in Hampshire haymaking a like crop would have cost 1*l.* per acre. I thus saved a rent on this rather poor land. In 1883 I cut and ensilaged a rather light crop for 7*s.* 6*d.* per acre.

30. *Rations per cow.*—About 50lb.—that is, roughly, one cubic foot.

31. *Quality of butter.*—Very good, and wonderfully good colour. I tried once three cows, feeding on crushed oats, linseed cake, and particularly good hay. When fed on half the quantity of oats, and ensilage *ad lib.*, but no cake, they gave 25 per cent. more butter.

32. As stated by Mr. Easdale, of Pepper Arden, near Northallerton, silos perform three operations—making hay, stacking, and thatching hay. I find the buildings very useful, whether empty or not, for storing chaff, hay, straw, corn, &c.

33. *Analysis.*—Mr. F. Woodland Toms sent me the following analysis and notes:

Volatile Matters:	
Water	70·37 per cent.
Acetic acid (free)	0·20 ,,
Alcohol	0·08 ,,
Solid Matters:	
Albumenoids*	4·14 ,,
Fatty matter	0·80 ,,
Soluble Carbo-hydrates:	
Sugars	0·55 ,,
Starchy matters	3·58 ,,
Pectous compounds (gum, mucilage, &c.)	8·56 ,,
Insoluble Carbo-hydrates (fibre)	9·49 ,,
Ash	2·23 ,,
	100·00

* Equal nitrogen (all calculated as albumenoids), ·654 per cent.

Mr. Woodland Toms remarks that "This Romsey ensilage is, like the French, a very valuable feeding stuff. In composition, its dry matter

closely resembles that of hay of good quality; indeed, the albumenoids, or flesh-formers, are considerably higher than in Dr. Voelcker's averaged analyses of hay—doubtless owing to the fact that it was cut so young." In the following table, furnished by Mr. Woodland Toms, is stated the average composition, as given by Dr. Voelcker, of absolutely dry hay deduced from twenty-five analyses; and Mr. Toms compares it with the Romsey ensilage from my pits, and also with some from those of the Vicomte de Chezelles, in France. The three columns show the compositions of the *dry* substance in each case:

	Hay, average of 25 samples.	Grass ensilage, grown at Romsey.	Clover and grass ensilage, from the Vicomte de Chezelles.
Albnmenoids	9·88	13·97	18·35
Ammonia	—	—	0·12
Non-nitrogenous extractive matter...	48·09	(43·77)	(37·22)
viz., Acetic acid	—	0·67	2·41
Alcohol	—	0·27	3·62
Sugars	—	1·86	5·92
Starchy matters	—	12·08	4·49
Gum, mucilage, &c.	—	28·89	20·78
Fibre	31·80	32·03	28·87
Fatty matter	2·99	2·70	4·15
Ash	7·24	7·53	11·29
	100·00	100·00	100·00

Such are, in my opinion and practice, the details of ensilage and the method pursued in making it. From a more general point of view, I would point out the great utility of the system in securing late second cuts of various green foods, such as lucerne, giant sainfoin, seeds, &c., &c., at a season of the year when there is little chance of successful haymaking.

There is also the very great advantage of clearing the ground at once. There is no fear of the second crop of, say, Italian rye-grass growing up through the rows of the mown grass, as we sometimes see in a showery haymaking time. Neither shall we see the long lines of yellow grass from which the mown grass, after remaining some time in the rows, has been turned. I seize a favourable chance one fine day, and I cut a certain acreage; by nightfall that amount of my winter fodder is safe under cover. I have no turning, and turning, and turning again of grass, only to see it damaged every time in a greater degree by successive showers, each one of which seems to fall just when the hay is fit to carry. In a word, the anxiety, trouble, and, I may add, beer-drinking, usually connected with the saving of the grass crops, are by the system of ensilage very greatly reduced.

I would also notice the increased time the system of ensilage gives to get in, fairly early, a second snatch crop. For instance, I have now (Feb.

1884) 25 acres of winter vetches and oats, sown early in October, 1883, and now looking very well. If the season proves an average one I shall mow these 25 acres for ensilage about the 15th of May. I shall then have plenty of time to plough the ground and sow it with buckwheat (which grows well on my poor gravel soil, and makes capital pig-food when ground). With the buckwheat I shall sow Italian rye-grass for ensilage in 1885, manuring during next winter.

Again, I have 30 acres of rye. This probably will be ensilaged about the middle or end of April. Some of the land will be sown with swedes, kohl-rabi, and turnips in succession; some of it, like the vetch ground, sown with buckwheat and Italian rye-grass.

Even on my "seeds," some of which I shall cut only once and then plough up, I find the advantage of ensilage, as I can get the ploughs to work at least a week earlier than if I made the crop into hay.

As I have said before, both in the columns of *The Field* and elsewhere, ensilage is by no means a royal road to agricultural success. It is a great help to our previous ways of securing our grass crops; but it demands care, attention, "trouble," a considerable outlay of capital, and a great amount of over-loooking at the time of cutting and carrying.

The American estimates of ensilage may be true enough as regards that country. Ensilage cannot, in my opinion, be of equal importance in England. The demand for good hay in England is enormous, and as our towns increase it is likely to grow. I have had some correspondence with gentlemen who wish to make ensilage into saleable bales or trusses; but I cannot say I think the project feasible. There is to be contended with a great ignorance of ensilage; and, when first seen, the smell and appearance of ensilage are not always in its favour.

Horses, as far as my experience goes, will eat rye-grass ensilage readily, but not vetch ensilage—why, I cannot say.

A truss of hay will keep any reasonable time; a truss of ensilage would, I think, heat in a short time; and a truss of ensilage, if cut the same size as an ordinary truss of hay, would be very heavy and awkward to handle.

On a farm, conducted as mine is, selling nothing but butter and meat, consuming all the grass crops, the straw, roots, and corn on the land, and, indeed, buying straw and cake in considerable quantities, ensilage is an unmixed boon; but to those who have a good market (with a reasonable certainty of getting their money) for their hay and straw and corn, I would say "do not meddle with ensilage."

If you have ensilage you must have cattle to eat it, and this (say you farm a moderate extent—200 acres) means a large expenditure of capital in buying those cattle. If you make hay, you can sell it to the neighbouring towns and bring back manure; saving the labour, anxiety, and, in these days of imported foreign disease, the risks of a considerable herd of cattle.

I may add that I have never had any difficulty in getting cattle to eat ensilage, and I have never found any bad effects from its use. I think some nitrogenous food, such as crushed oats, cake, &c., ought to be given with it. A. H. GRANT.

Abbotswood, Romsey, Hants, Feb., 1884.

MR. WILLAN'S SILO, THORNHILL PARK, HANTS.

SIR,—As the question of what a silo may cost to construct in different localities is one of general interest at the present time, you may think that the actual cost of one I have just completed may be worthy of publication in the columns of the *Field*.

I excavated, at the beginning of March, in the bay of a roomy barn, a pit of the cubic capacity of 76 yards, Two of my labourers undertook the job at 8*d*. per yard, and I carted the greater part of the gravel which came from it with my own farm carts. We were fortunate enough to begin with about 2ft. of sharp gravel, which was put on one side to make concrete blocks, to be used as weights. We then came on a quantity of red gravel, which continued to the bottom of the pit, and which, though rather sticky, with too large a proportion of clay, was of fine binding quality, and was certainly worth more than the trouble of carting a short distance, to cover a yard and several paths which needed repair.

I had by me a quantity of old bricks from some cottages which I had pulled down, and with these I commenced to build the walls of my silo. The pit was dug at one end of the barn, leaving room for a similar pit alongside of it; and, with a view to its future construction, I had the inside built of 9-inch work, and perpendicular, in order that it might serve as the parting wall of two pits. The other three walls were of only 4½-inch work, which was considered quite sufficient, as the sides were so sound and solid; and they were constructed with a slope or batter of 2in. in the depth of the pit, which was 10ft. It will be seen, therefore, that in length the pit was 4in. shorter at the bottom than the top, and in width it was 2ft. narrower.

The bottom was covered with a layer of four inches of rough stones, which had been screened from the concrete gravel first excavated, and this was again covered with a layer of bricks. This floor was then grouted in and covered with cement, the sides also of the pit being cemented up to the top. The total cost has been:

	£.	s.	d.
Excavation, 76 yards, at 8*d*.	2	18	0
Bricklayer, 12½ days, at 6*s*.	3	15	0
Labourer, 18 days, at 3*s*. 3*d*.	2	18	6
7 casks 1 bushel cement	5	5	0
7 loads of sharp washed sand	2	16	0
6 loads of pit sand	0	18	0
Total	£18	10	6

The dimensions of the silo now that it is completed are (at the top) 16ft. 4in. long, 11ft. 4in. wide, and 10ft. 2in. deep, and the capacity is within a small fraction of 1850 cubic feet. This capacity will, at 50ft. to a ton, be 37 tons, and the cost comes to 10*s*. per ton, and a little over 2½*d*. per cubic foot. The work is good and solid, and the pit gives every promise of being perfectly dry.

I have procured twenty deal battens, 9in. by 2in., with which to cover the ensilage, and their cost was 50*s*. These have been screwed together with coach screws, and divided at intervals of 18 inches with pieces of board; and being placed on the barn floor, we have just completed our first batch of concrete blocks in them. These blocks measure 18in. by 9in., by 9in., and weigh, when dry and hard, just 120lb.

I have given you my experience in making this pit for what it is worth, but of course a similar pit in a different locality may cost more or less. At any rate it is not likely, I think, being well built, to suffer much from decay; and the small sum chargeable annually as interest on the outlay and for depreciation will be amply compensated for by the saving in the labour of turning the green fodder into ensilage instead of hay.

Thornhill Park, Bitterne, April 18, 1883. FRANK WILLAN.

MR. SCOTT'S SILO, ROTHERFIELD PARK, HANTS.

SIR,—I inclose you the analyses made by Dr. Voelcker, F.R.S., of the produce of the same field of clover and rye-grass. The hay was made in the beginning of July from the first cut, the ensilage in the beginning of September from the second cut. The hay was got up in showery weather, and was consequently not of first-class quality. The ensilage was cut and pitted the same day without being chopped, and I have been feeding it to cattle for a month. They eat it greedily.

Composition of a Sample of Clover Hay made July, 1882 (first cut).

Moisture	18·01
*Albuminous compounds (flesh-forming matters)	13·01
Acetic Acid	·60
Mucilage, extractive matters, digestible fibre, &c.	40·25
Indigestible woody fibre (cellulose)	22·01
Mineral matter (ash)	6·12
	100·00
*Containing nitrogen	2·08

Composition of a Sample of Ensilage, made September, 1882, from same field as clover hay (second cut).

Moisture	79·05
*Albuminous compounds (flesh-forming matters)	2·21
Lactic acid	1·20
Mucilage, extractive matter, digestible fibre, &c.	9·33
Indigestible woody fibre (cellulose)	6·35
Mineral matter (ash)	1·86
	100·00
*Containing nitrogen	·35

Roughly speaking, one ton hay equals four tons of ensilage. A. VOELCKER.

I have now been trying experiments with ensilage for seven years, and I believe it to be a good fodder when made of the proper materials.

ARTHUR J. SCOTT.

Rotherfield Park, Alton, Hants, Jan. 16, 1883.

[To compare analyes of fodders, as here, where one contains about 80 per cent. and the other 18 per cent. of moisture, is not easy, unless the results are re-calculated, after omitting the water. This being done, the percentages stand as follows:

HAY.		ENSILAGE.	
*Albumenoids	15·87	*Albumenoids	10·55
Acetic Acid	0·73	Lactic Acid	5·73
Mucilage, digestible fibre, &c.	49·10	Mucilage, digestible fibre, &c.	44·53
Indigestible fibre	26·84	Indigestible fibre	30·31
Ash	7·46	Ash	8·88
	100·00		100·00
*Containing nitrogen	2·54	*Containing nitrogen	1·69

From the very large amount of acid that had been formed, and the altered proportions in other respects, it looked as if an undue amount of fermentation had been going on in the silo. We accordingly requested particulars as to the weighting, and Mr. Scott informed us that the weight was applied at the end of a lever, and when the fodder had sunk in the pit the weight rested on the ground, and ceased to act. This would account for an admission of air, such as would produce the undue fermentation.—ED.]

FOUR DORSETSHIRE SILOS.

DURING a recent visit to Dorsetshire, I went to see some silos which have been made and filled during the last summer. Three of them belong to Mr. Miller, an enterprising agriculturist near Sherborne, a brother of Mr. Miller so celebrated in the annals of coursing. Hearing that Mr. Miller very kindly allows his silos to be inspected by those interested in the matter, I drove over, but was not so fortunate as to find him at home. An intelligent man of his, however, attended, and gave me every information; and I venture to send you an account of what I saw in the West.

Mr. Miller began his silos by excavating a straight channel about 60ft. long, 12ft. wide, and 12ft. deep, through a mound of loose limestone rock. This channel he lined, and divided into three silos with mortar walls, each silo being 20ft. long by 12ft. deep, and 12ft. wide. The bottom of the silo I saw was not paved, and it seemed to me that, with a succulent crop, the superincumbent pressure must squeeze out a considerable quantity of valuable fluid, which would in this case inevitably be wasted by draining away through the porous limestone rock. The three silos are roofed with light deal rafters, covered with thatched

hurdles. The whole thing was carried out well (with the exception of the absence of a paved floor), but at the same time with due regard to economy.

Silo No. 1 was filled with rye-grass, older than it ought to be for making ensilage. It was cut into chaff and well trodden by horses. It was then covered with boards and weighted with the limestone taken from the channel—the weight, so far as I could judge, not exceeding 50lb. to the square foot. An expert in ensilage would not have considered this as by any means a good sample; but Mr. Miller's man told me that the cows eat it with great relish, that they would leave good hay for it, that they had increased their milk about 10 per cent. over the yield of the year preceding, and that the man who bought the milk had made no complaint as to its quality.

Silo No. 2 was filled with vetches, rye-grass, and hop clover. This silo, not being accessible to horses, was only trampled by the workmen. It was weighted in the same manner as No. 1. When opened, the thermometer showed 87° at 3ft. from the top. The hop, clover, and rye made a fair sample, and I hear the stock did well on it. The vetches were not so good; the smell of the sample sent me was very unpleasant. There is evidently much yet to be learnt about the pitting of vetches. Mixed with rye or green oats, they seem invariably to do well, but by themselves seem a very uncertain crop.

Silo No. 3 was filled with meadow grass chaffed. It was opened last week, and the sample of ensilage sent is a good one, rather dark in colour, but aromatic in smell, and one which the stock will be sure to like.

It was very public spirited of Mr. Miller to make three silos as an example to the neighbourhood, and he will surely find them a most useful adjunct to his farm for many years to come.

Silo No. 4. While in Dorset I was also present at the opening of a silo at Leweston, near Sherborne, the residence of Sir Richard Glyn. Being anxious last summer to give the ensilage system a fair trial, he pitted some meadow grass and lawn mowings in a sawpit, which is under a covered shed. The grass was put in unchaffed, was covered with straw, and weighted with heavy flags of Kineton stone, which seemed of ample weight. The grass was put in very wet, and the thermometer when the silo was opened, showed 72°. The sample of ensilage was good, both in colour and smell. If it had a fault, it was a little too acid. The cows took to it at once, and Sir Richard Glyn's bailiff writes: "The cows have become so fond of the ensilage that they do not care to eat their hay unless we mix some with it. We have some liquor in the bottom of the silo, which is given to the pigs; they like it very much. I shall be quite sorry when it is done, and so will be the animals. I am quite sure it increases and improves the milk."—From a letter by Major FITZGERALD (*Field*, Jan. 12, 1884).

MR. HARRIS'S SILO AT HALLWILL, DEVON.

BETWEEN four and five hundred agriculturists, hailing from all quarters of Devonshire availed themselves, on Nov. 29, of the invitation of Mr. W. J. Harris, of Hallwill Manor, near Holsworthy, to come and see, and judge for themselves, of the experiment which he had carried out. In these parts the farmers have an up-hill fight to grow anything and to succeed at all, for the land is poor, almost on a level with Dartmoor itself, and the rainfall is very heavy. It is a cold, exposed, and bleak district, wherein everything is late to ripen.

Mr. Harris, well known in his connection with the London corn trade, became lord of the manor of Hallwill about twelve years since, and is the owner of a large territory, of which he has about 1000 acres in hand. It is essentially mixed, rough, grazing land, the only corn raised being consumed on the farm, and grown chiefly for the sake of the straw. Impressed with the advantages of ensilage and of its special suitability to the district, Mr. Harris determined to try the making of some for himself. His silo was extemporised out of a disused manure shed. It is 35ft. long, 18ft. wide, and 10½ft. deep, partly above and partly below ground, and standing on the side of a hill, it has one end 2ft. below the surface, and the other about 6ft. below. Drains are laid round the foundations, the walls are built of stone, and are 2ft. thick. The floor and sides are cemented, and the place is covered with a substantial slate roof.

The filling of the silo was commenced on July 9. A waggon load of rough grass or rushes from a marsh was first spread over the bottom, then twelve loads of good meadow grass, cut and carried within an hour or two, were thrown in, and well trodden down. These twelve loads, the produce of 1 acre, were computed to weigh about 1 ton each. Two days after a heavy shear of clover and rye grass was cut, and seventeen loads, the produce of 2 acres, together with four loads of same sort from a third field, were carried to the silo, which now became full. Planks cut to the breadth of the silo were placed on the grass, and iron rails, blocks of stone, bags of sand, &c., to the extent of five tons were placed on them. On July 13, it having sunk at least 3 ft., the weighting was removed, and twenty-one waggon loads of clover and rye grass added, some of which was cut and carried during rain. On July 16 sixteen loads more of good meadow grass again filled the silo, and the surface was once more boarded over and compressed with weights, giving a pressure of, say, 70lb. to the square foot; this was afterwards increased to 130lb. The silo was now closed, and the bulk rapidly sank from 10ft. 6in. to exactly half that height. Whilst the silo was being filled, the grass was well trodden down, and about 6lb. or 7lb. of salt were sprinkled over each waggon load as it was thrown in.

In September the weights were removed, and the top was uncovered in order to allow of a second crop of clover buds being added. It was then found that from 2 to 4 inches of the top surface of the ensilage were rotten, but all below seemed sound and good. The greater part of this spoilt portion was removed before the clover buds (13 tons) were put in. More would have been carried had not the weather been so wet. Some of the first crops had been carried in a wet state, and with no bad result, as it turned out, but it was considered undesirable to imperil the experiment by carrying in so much rain water. After this second filling (which, by the way, proved a mistake) the silo was again boarded and covered with sand (not in bags now), and virtually and finally closed up and sealed, all air being as far as possible excluded.

On Dec. 15 the silo, which was estimated to contain about 90 tons of ensilage, was cut into sectionally at one end. The material was of a dark, yellowish-brown colour, lighter in some strata than others, moist even to wetness, and possesses a strong, penetrating, vinous smell. It has a sweetish, and by no means unpleasant, taste. There was no liquid at the bottom of the silo, and the top portions of the good ensilage were as wet as those at the bottom, showing that the moisture was evenly distributed by the pressure throughout the bulk. A cubic foot weighed rather over 40lb.

The cattle liked it, as the visitors had ample means of seeing. Calves were shown living well on it, and to horses and bullocks were offered at the same time oats, hay, and ensilage, the result being that the latter was preferred, and that so long as any remained the oats and hay were untouched.

After the silo had been inspected, Mr. Harris proceeded to explain to the visitors the cost, advantages, and other details of the production of ensilage. Although he did not regard this experiment as completely successful, he did claim for it more than a partial success, and quite enough to enable him to see his way to making it perfect another year. As to the construction of the pit, he admitted that there were obvious faults which would not have occurred if the building had been specially built and designed for the purpose to which it had been put. He had, however, an estimate prepared for him by a builder, by which it was found that a more perfect silo than this, of exactly the same size and shape, could be constructed, with top boards and all complete (with the exception of the weights), for 110*l.* The interest on this outlay at 5 per cent. per annum on 110 tons of ensilage, which is about the quantity it would contain, would be 1*s.* per ton. There were various ways in which this cost might be lessened. The upper part of the silo could be utilised for other purposes, and a clay bottom might take the place of cement.

It would be noticed that the upper layer of clover in the silo was imperfect. There might be several reasons for the failure of this portion, but he had given them the benefit of his experience, and had shown them

the experiment in its entirety, so that they could judge for themselves. He determined that they should see the bad as well as the good, and he had not endeavoured to hide from them the mouldiness which they saw in the upper portion.

T. L. A.

A later account from Hallwill Manor informed us that, as the silo was cut into and a greater distance from the door reached, the quality improved, and that there was hardly any, even at the top, which the cattle would not readily eat.

Mr Harris intends, we understand, to make ensilage on a much larger scale next season—probably to the extent of 1000 tons.

EARL FORTESCUE'S EXPERIMENTS.

At the annual meeting of the Devonshire Chamber of Agriculture at Exeter, in January, 1884, Viscount Ebrington, M.P., read a paper on "Ensilage," especially in regard to the experiments at Castle Hill, Earl Fortescue's seat near Southmolton, Devon. The silo is above ground, the interior surface of the walls and the floor cemented, and the roof of corrugated iron. The dimensions are 19ft. long by 6ft. 9in. wide, and 5ft. 3in. deep, giving a cubic capacity of 673ft. There is no drain at the bottom.

On July 25 the silo was filled with the grass of about an acre of unwatered meadow, which was cut with a chaff-cutter into lengths of about three-quarters of an inch, and put into the silo the same afternoon, nearly $1\frac{1}{2}$cwt. of salt being mixed with it. Ploughed and tongued boards were placed on the mass, and sawdust and big stones on them, till a pressure was obtained of about 50lb. to the square foot. Ten days later, the ensilage having subsided, some grass was cut in an orchard and put in as a second filling to the depth of a foot or so. The weights and roof were then replaced, and the silo was not opened till Dec. 20.

It was reckoned that they put into the silo the produce of $1\frac{1}{4}$ acre of ground, which, under other treatment, would have yielded about 2 tons of rather coarse hay. The entire expense of cutting, filling, &c., was 37*s*., or a little over 28*s*. an acre, the odd 8*s*. being the cost of the chaffing, which he did not think paid for doing.

When they opened the silo, they found that the contents occupied 513 cubic feet out of the 673, the capacity of the silo. The weight per cubic foot was 36lb., so that they had secured over 8 tons of forage at a cost of barely 4*s*. 6*d*. per ton. At first the stuff looked only fit for the dungheap, and the cattle did not seem inclined to take it. Within forty-eight hours, however, nearly all the cattle were eating the new food readily, and did not even turn up their noses at the rather highly-coloured second filling. After allowing a few days for the cattle to get accustomed to the new food, experiments were instituted with a view to testing its value for dairy purposes.

Nine Devon cows were selected and divided into three sets, the milk of each set being carefully measured. They were then put on different diets, the butter was weighed every day, and again at the end of the experiment. The three cows in class A. were fed, between Dec. 26 and Jan. 16, on the following daily diet., viz., 6lb. decorticated cotton cake, 6lb. undecorticated ditto, 6lb. oilcake, 6lb. pollard, 16lb. wheaten straw chaff, and 36lb. hay. Class B. received the same as Class A., with the exception that 100lb. of ensilage was substituted for the hay. Class C. (experimented upon to Jan. 7 only) received the same as A. and B., but with 150lb. of ensilage in lieu of chaff and hay.

The results showed, in his opinion, that ensilage might be used to a considerable extent as a food for dairy cows without detriment, if not indeed with advantage, to the production of milk and butter. The average yield of butter per day during the period of experimenting was: Class A., 1lb. $\frac{6}{7}$oz.; B., 1lb. 11$\frac{1}{4}$oz.; C., 1lb. 10$\frac{1}{2}$lb. It was found that, if used too freely, the ensilage gave a flavour to the butter, and they had therefore not found the experiment with C. cows a success. The animals lost condition, and there was a distinct falling off in the results as compared with B.

As to comparative value, their experiment showed that, in round numbers, the grass that would make one ton of hay would make, at less cost, four tons of ensilage, which were equivalent, for feeding purposes, to a ton and a third of hay or straw chaff. It seemed that, with cotton cake alone, ensilage would not do, but with the mixture of cake and pollard it appeared quite fit to take the place of hay or straw, or both; for the B cows kept their condition very well all through.

As to the silo, heavy weighting paid, they would get more into the silo and check excessive fermentation and dampness. With regard to the question of salt, the balance of opinion seemed to be in favour of adding a proportion of salt; he did not believe it to be necessary, however, but it probably improved the flavour and made the ensilage more palatable.

MR. H. QUARTLEY'S SILO AT MOLLAND, N. DEVON.

In the *North Devon Herald* Mr. H. Quartly, of Molland, Southmolton, gave the following particulars of a plan which, he says, could be adopted by the smallest farmer, with very little help from his landlord:

"On July 19 I commenced making the silo, and on the 23rd I had it completed and ready for filling in. Its dimensions were—30ft. long, 9ft. wide, 9ft. deep. The plan adopted was to sink out a trench parallel with a dry fence, which formed a wall on one side, and the rubbish from the trench formed a wall on the opposite side, also one end, the other end being open, and the whole sunk to the same level as the ground outside the entrance. The cost of this did not exceed 1*l.*, and in the silo thus formed I put four acres of grass from a watered meadow, and a

heavy crop. I commenced filling on the 24th July, and completed it on the 26th, carting the grass away after the scythe, and treading every layer of about two cartloads down tightly with a horse, sprinkling a little salt over each layer. On the 27th I had the open end banked up with sods and earth, and the whole covered, first with hedge prunings and coarse grass, then with a layer of earth about six or eight inches in thickness, after which it was roofed over and thatched.

"On Nov. 1 opened it from the top, merely to test it, and am pleased to say it is highly satisfactory, and has far exceeded my expectation. On removing the earth I found that the hedge pruning and coarse grass was mouldy to a depth of about eight inches, after which the ensilage came out perfecty sweet, with a peculiar aromatic smell, and, on giving it to the stock, both horses and cattle ate it readily. I do not intend opening the silo for feeding purposes until after Christmas."

MR. CUBITT'S SILO AT FALLAPIT, S. DEVON.

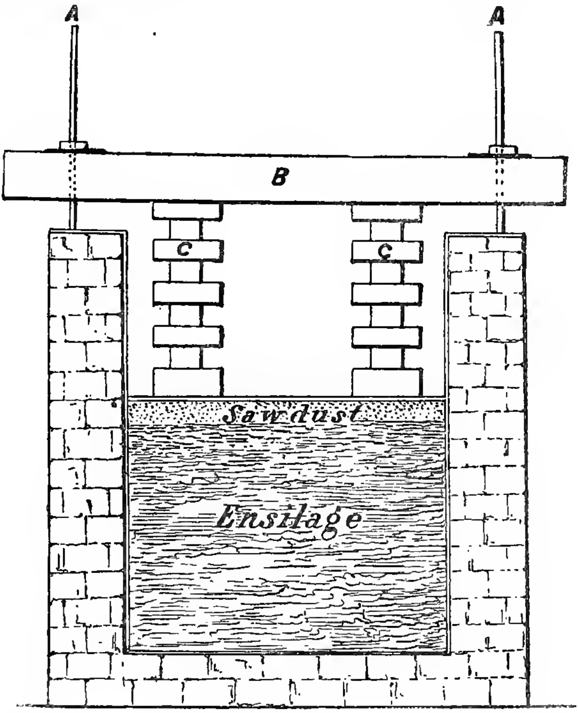
Mr. W. Cubitt, of Fallapit, East Allington, invited the leading agriculturists of the neighbourhood to his farm on Jan. 31, for the purpose of witnessing the opening of his silo. It contained about 70 tons of fodder (the produce of 7 or 8 acres), and is about 15ft. 2in. square, and 15ft. deep. The grass was stored in June and July, newly cut, and, for the most part, in a wet condition, for rain was falling at the time. A small quantity of salt was mixed with the grass as it was being placed in the silo, and, after being trodden down well, heavy stones were placed over it, giving a pressure of about 150lb. to the square foot. On opening the silo, about 4in. of the top portion of the ensilage was damaged. The ensilage taken from the silo was given to the bullocks—and Mr. Cubitt has some two hundred on his estate—and by many of them it was eaten very freely; others, however, seemed indifferent about it.

In thanking Mr. Cubitt for affording agriculturists the opportunity of witnessing the experiments, Mr. Ilbert said he considered the new mode of feeding cattle was not only most useful, but most practical, when they had regard to the nature of their changeable climate. And, in reply, Mr. Cubitt said he believed they had the natural facilities for producing beef and butter to a much larger extent than in any county in England; and he thought, if they were successful in making ensilage a profitable food, the advantages they possessed would be greatly augmented.

We received from Mr. Cubitt's steward a sample of the ensilage, consisting of water-meadow grass that had been carried in heavy rain. The exterior of the sample had a rather pungent odour that is characteristic of ensilage of coarse wet grass; but the centre of the mass, that had not been exposed to the atmosphere, was free from this smell, and seemed very well preserved.

MR. JOHN MEAD'S SILO, FALMOUTH, CORNWALL.

THIS silo (of which the sketch and particulars were sent by Mr. G. Olver) is about 8ft. deep, and 6ft. diameter, perfectly round, and lined with $\frac{3}{4}$in. ploughed and tongued flooring; the bottom and the cover are of the same material. The two upright bars marked A A are screws; the stout crosspiece B has two holes bored in to admit of these passing up through these holes, and large nuts are then screwed or turned around until they press tightly on the beam.



The silo was filled with coarse grass in October, 1883, and the beam screwed down daily for about three weeks. What was the pressure put on it is not known with any certainty, but when the silo was opened, in the second week of January, the ensilage was found "as hard as a cheese." Next to the sawdust about half an inch of the grass was a bright green; this smelt very strongly, and was thrown away. This was the only waste. Cattle and horses did not seem to care about the very top, but eventually every animal to which the ensilage was offered ate it freely, especially the cows; and the horses seem to do very well indeed on it.

MR. WILLS'S SILO, BLAGDON, SOMERSET.

Mr. W. H. Wills, of Coombe Lodge, Blagdon, writing to the *Agricultural Gazette*, says: "I built a silo, 14ft. by 12ft., and 13ft. deep. The ground was a natural slope, causing 8ft. of excavation at one end. This involved a little quarrying, owing to the outcrop of a bed of limestone. We made the walls 2ft. thick of rubble masonry in brown lime. The floor was made watertight, and covered with rough flagging from my own quarry. The walls were topped with an Λ roof, covered with tiles. The cost of all this, done by my own men, I estimate at 36*l.* for labour and materials. On July 3 we began to cut 4½ acres of clover, which we reckoned would have given about 1¾ ton of clover-hay to the acre, as the crop was not a heavy one. As the clover was cut it was hauled to the barn, which adjoins the silo, and there cut by steam into 1½in. lengths, thrown into the silo, and firmly trodden in successive layers by half a dozen labourers. On July 5 the silo was entirely full, though sinking a little daily. We then covered it with a layer of straw, 3in. thick, over which were laid common deals close together, but with 1in. space at each end. Above these was piled quarry rubble, about 3cwt. to the square foot. The mass continued to sink until the solid material was reduced to a little over 7ft. On Nov. 3, after four months packing, we opened the silo, and, with the exception of a very small quantity, perhaps 2cwt. (just inside the doorway, which had been bricked up, leaving a recess of 1ft.), the whole mass was perfectly sweet and good. The colour was something between grass and hay, and the smell rather like fresh grains. We have been giving it daily both to young stock and to milch cows, all of whom eat it with great relish."

MR. KEMBLE'S SILO, EAST HARPTREE, BRISTOL.

On Sept. 9, 1882, I commenced cutting twenty-five acres of oats (Black Tartars). Owing to the wet season, I was unable to harvest this crop, and therefore determined to adapt and fill a silo with oat-sheaf chaff. On Nov. 6 I began to fill the pit, cutting the straw to chaff about 1in. in length. By this time the oat sheaves were in a thoroughly sodden condition, and the corn in them had so generally "sprouted," that apparently all was worthless except as manure. We continued cutting and filling at intervals, and trod in the final chop on Nov. 11. Nine loads were cut up in this way, which I estimate at 13½ tons. While filling the pit I mixed with this wet chaff 3cwt. of salt and 100lb. of "Simpson's spice." Having filled the pit, I had a layer of dry straw laid on the chaff, then boards, over which I spread layers of sawdust and oat cavings to exclude the air, then, by way of pressure, I placed several tons of freestone on

the top. The silo in which I made this experiment is a stone and brick-walled room with concrete floor, measuring 16ft. by 9ft. by 10ft.

East Harptree, Bristol. C. A. Kemble.

On March 14, 1883, this silo was opened; and, after the covering boards, &c., had been removed, it was found that a little of the preserved fodder was fusty, and this only so slightly that it need not be wasted. Breaking further into the pit, a fragrant odour soon pervaded the homestead in which the experiment was tested, for a cloud of hot vapour escaped from the ensilage, and reminded one, by its smell, of a newly heated hayrick. A thermometer was plunged as far as a man's arm could reach towards the centre of the mass, and registered 110°. Some of the ensilage was immediately carried to cattle and horses, and was readily eaten by them.

An average sample was drawn by Mr. Kemble, and immediately packed in an air-tight tin and sent for analysis to Mr. Bernard Dyer, F.C.S. The ensilage, Mr. Dyer states, had a pleasant aromatic smell and a pleasant, though very distinctly acid, taste. Its percentage composition was as follows:

Water	48·08
Oil	2·13
*Albuminous compounds	3·15
Sugar (glucose)	0·50
Free acid (calculated as acetic acid)	0·83
Mucilage and digestible fibre	26·34
Indigestible woody fibre	15·70
†Mineral matter (ash)	3·27
	100·00
*Containing nitrogen	0·50
†Containing silica	1·66

Mr. Dyer adds an expression of regret that he had not an opportunity of analysing a sample of wet chaff before it was put into the pit, as the analysis of the ensilage alone throws, at the best, but an uncertain light on the question of the loss that may have occurred by fermentation in the silo.—*Agricultural Gazette.*

SILO AT NORTH CURRY, SOMERSET.

The Rev. R. C. Lathom-Browne had an experimental silo constructed in the side of a shed, all being above ground. Its dimensions are 9ft. by 9ft. by 7ft.; two sides are rough walling, and the other two sides are made of 1¼in. pine planking, tarred at the joints. The grass was taken from a rough orchard, carried dripping wet in July; the time occupied in filling was about ten days. The pressure was about 1½cwt. of large rough stones per square foot. When opened in January the ensilage was not badly preserved for such coarse wet grass, though rather unpleasant in smell.

LORD TOLLEMACHE'S SILOS AT PECKFORTON.

Lord Tollemache of Helmingham being impressed with the value of ensilage as food for dairy cattle, and believing that it would be of considerable advantage to his tenantry, determined to carry out some experiments on his Peckforton estate, which is situate in the heart of the cheese-making district of Cheshire. Accordingly he had an open barn converted into four silos by bricking up the spaces between the pillars, as shown in the plan already given in the chapter on silos.

Three of these silos are 8ft. deep, 15ft. long, and 12ft. broad; No. 4 is 11ft. deep. and goes 3ft. underground—this being for the purpose of testing the difference of effect of the earth on the ensilage. In each case the wall is lined with cement, the floors being of concrete. Inside each silo there is a mark entirely around it at every 2ft. of its height, so that at any time it can be seen what is the height of the fodder within. About ten yards from the corner of No. 4 silo, an engine of 4 horse-power nominal is stationed, and beside it a chaff-cutter.

Closely adjoining the silos are two pieces of common meadow land, which usually produce about 80 tons of hay, and the machine was put into one of these on the 13th June. As soon as mown the grass was carried to the cutter, and cut into chaff, and while this operation was on, 2lb. of common salt per cwt. was mixed with it. The chaff was then wheeled through the doorways (*a*) into the silos, as much as possible being got in in this manner, after which the shutters above (*b*) were opened and the doors fastened by being screwed to the jambs, and afterwards bricked up on the outside. The grass chaff was frequently levelled and rammed down. On the silos becoming filled up to the level of the shutters (shown by the mark *d*), ten wooden shutters, each three feet wide and six feet long, were placed on the top of the ensilage, and the whole then covered with bran. Lord Tollemache having at hand a number of boxes which had contained tins of gaseoline (used for lighting Peckforton Castle), these boxes were filled with gravel and used for weighting the silos. The quantities of forage put into the silos were as follows:

No. of Silo.	Date of filling.	Material.	Weight.	Acreage.	Date of Re-filling.	Sinkage when re-filled.	Weight put in to refill.	Total Weight.
			tons. cwt.	a. r. p.		ft. in.	Tons.	tns. cwt.
1	June 20	Upland Grass	17 0	3 2 0	July 25	2 6	8	25 0
2	June 27	do.	17 3	2 2 20	,, 25	2 1	7	24 3
3	July 3	do.	18 10	2 2 0	,, 26	1 8½	6½	25 0
4	July 4, 5	Oats and Vetches.	35 6	2 3 37	,, 26	1 9½	8	43 6
Land mown for refilling silos				4 0 0				
Total acreage.....................				15 2 17	Total weight...			117 9

The grass put into No. 1 silo at the first filling was a light crop of about $4\frac{3}{4}$ tons per acre, mown and carried two hours after a night's rain; No. 2 was filled with a fair crop of about $6\frac{1}{4}$ tons to the acre; that in No. 3 was a good crop of about $7\frac{1}{2}$ tons to the acre; and that used for refilling also weighed about $7\frac{1}{2}$ tons to the acre. The oats and vetches put in No. 4 silo weighed about $11\frac{1}{2}$ tons to the acre. The capacity of silos 1, 2, and 3, is 1440 cubic feet each; No. 4, being 3ft. deeper, has 2060ft. capacity.

On the 28th of November one of the silos was opened, and in order that visitors might see the result of the experiment in the best possible manner, a pathway the width of the door, and from the bottom to the top of the silo, was cut through the mass of ensilage. Several visitors were thus able to get in the silo at once, and abundant opportunity was given everyone for judging the contents. The ensilage had the appearance of a compact mass of dark, yet bright, brown colour, and it had a fresh, slightly pungent, and rather agreeable odour. There was considerable moisture in the mass, but it was evenly distributed, and was not more apparent at the bottom than at the top. The ensilage had sunk two feet from the point at which the shutters were placed upon it, and for about an inch and a half below the shutters the ensilage was black and discoloured; but beyond this, there was nothing in the experiment that could be described as unfavourable. Lord Tollemache told his visitors that he expected a thicker layer than this to have been spoilt, as the part nearest the external atmosphere usually went wrong. The same thing were found in Lord Walsingham's silos at Merton, in Norfolk.

As a matter of fact, the large number of persons present agreed that the experiment must be put down as a great success. "But," it was said by some of the farmers, "will the cattle and horses eat it?" Here Lord Tollemache took a handful of the ensilage and offered it to a young, pure-blooded mare that he had driven from the castle. This animal, fed with the best corn in the Peckforton stables, took the ensilage greedily, and some young cows in the yard were also offered the new food, and ate it up with great relish.

After this, however, "No. 3" silo was, by Lord Tollemache's direction, bored. This silo was filled on a dry day, and thus contained only the natural moisture of the grasses, plus the salt used. The whole mass was much drier than the one opened, and its contents were not so well liked by the farmers present.

During the morning Lord Tollemache made some explanatory speeches on the general subject of ensilage, and his own in particular. His lordship said that undoubtedly ensilage was spreading. Last year a friend of his had made 40 tons, and this year he had preserved 120 tons. In the Peckforton silos the contents were got off land yielding between seven and eight tons per acre, for he found that a cubic foot of his own ensilage weighed 48lb. In estimating his silos as containing 118 tons, he had only reckoned on 42lb. per cubic foot, so that he had saved

more from his land than he had expected. He was convinced that in preserving ensilage great regard must be had to the quality of the food to be made, and therefore care must be taken in its preservation. A great thing was to exclude all external air from the silo, and to allow the internal air to be expelled by weighting properly. To help this operation it was much better to cut the grass into small pieces at the time it was packed in the silo, as by this means less room was taken up, and the mass was likely to assume a compact form sooner than if the grass had been put in without being made into chaff; and when this was done there was not so much internal air to be expelled. Although the mass was so moist, not a drop of water was found in the pit—it was so evenly distributed in the ensilage. On the future of ensilage Lord Tollemache said that his object had been to demonstrate its practicability on ordinary farms, and he thought he had shown them enough to make farmers persevere further in utilising this agency in stock feeding.

Subsequently, when the cows came to be fed regularly upon the ensilage it was found that the large amount of salt mixed with the grass had the effect of diminishing the milk supply considerably; and the quantity of of ensilage given to the animals was accordingly reduced from 30lb. to 15lb. per day, and mixed with chaffed hay. Upon this being done, the cows again began to give their usual supply of milk.

About three months after the opening of the silo Lord Tollemache issued to his tenantry a circular giving a series of "questions and answers" somewhat similar to those appearing on page 172, relative to silos and ensilage, and embodying the results of his personal experience. He afterwards invited his tenants to meet him at Peckforton Castle on the 17th of March, so that he might learn their opinions on the subject, and their wishes as to the construction of silos upon their farms. At this meeting he proposed to build silos for all those who wished to have them, on the condition that if the making of ensilage proved of advantage, they should pay 5 per cent. on the outlay; but if it proved the reverse, notwithstanding every care had been taken in the filling of the silos and properly weighting them, they should pay nothing; and in case of any difference of opinion arising on the subject, it should be left to arbitration. This offer was at once accepted by a number of the tenantry, one of whom, in returning thanks, described it as the most liberal offer it was possible to conceive.

On April 2 Lord Tollemache opened his silo which had been filled in the previous June with wet grass. Rain had been falling heavily during the night, and the grass was taken to the chaff-cutter full of moisture. An American, who had been present at the filling of silos in America under similar conditions, told Lord Tollemache that his ensilage would be worthless, as it would turn out to be rotten. His predictions have been falsified, for when the silo was opened it revealed the ensilage in a sweet and sound condition, and, in the opinion of the practical farmers present, better adapted for dairy stock, from the moisture it contained,

than either of the other silos. In the course of conversation, Lord Tollemache said that he had given orders for the construction of two silos on each of his ten farms in Cheshire. His lordship added that he should now have no hesitancy in filling these silos in any weather; if at all, he would undoubtedly give preference to grass containing moisture.

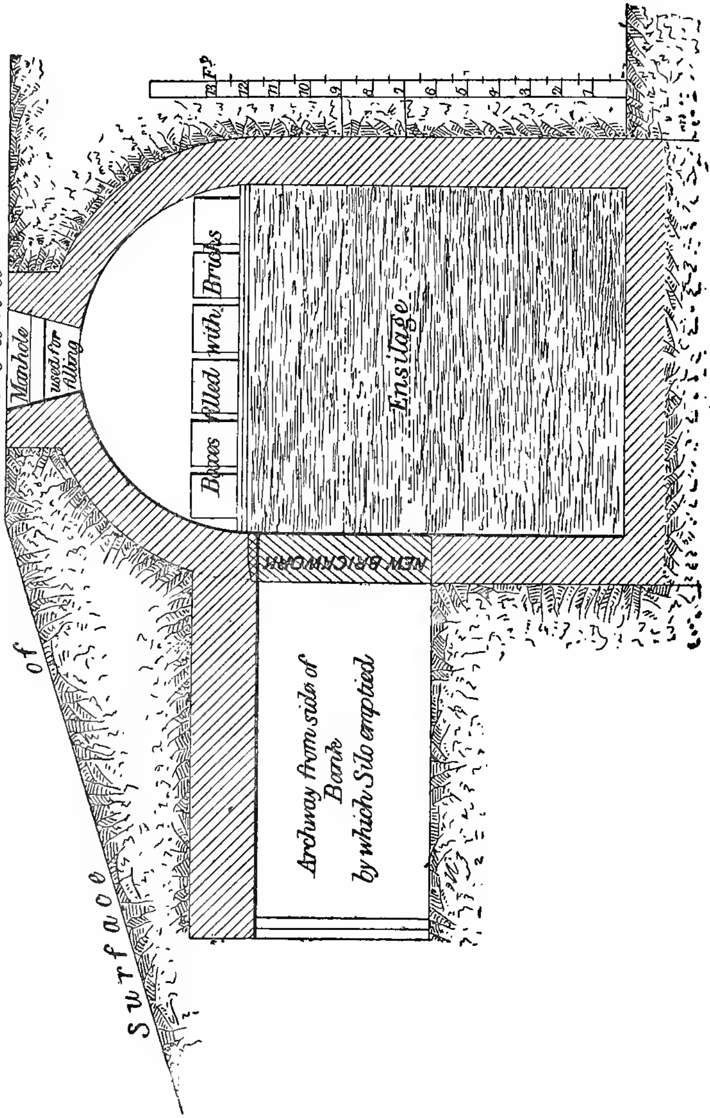
LORD EGERTON'S SILO IN TATTON PARK.

THE opening of this silo, which had been filled in July, 1883, took place on the 12th of February, 1884, in the presence of a considerable assemblage. The following sketch of the silo and details of the experiment have been supplied by Mr. J. T. Smith, Lord Egerton's agent. The original drawing gave several views of the silo at different stages; but it will suffice here to reproduce the one representing the pit at the end of the second day's filling (July 5). On July 27, the contents having sunk to 8½ft., a further filling took place, again raising the height to about 12ft. On Aug. 20, the level of ensilage stood at 9ft. 6in., having sunk 2ft. 3in. since last filling. When opened on Feb. 12 it had sunk 1ft. 6in. more, being then 8ft. in height.

An old icehouse in the park was chosen for the experiment. The walls on the inside were plastered with cement, the original entrance being blocked up, and a new entrance made in centre of dome, as shown by the plan. The size of the house is: Diameter, 11ft. 6in.; height to square, 12ft. 6in.; area, 104 square feet.

A portion of the park, fenced in and near icehouse, and which had often been mown without a fair return of keep, was chosen as suitable to supply the crop, and, though amongst it there was a proportion of fine grass, the greater quantity was rough and coarse.

On July 3, the portable engine, chaff cutter, and all other necessaries were on the ground. On July 4, at 8.15, the mowing machine started, and at nine the first load of grass left for the silo, the chaffcutter being got to work at 9.15. State of grass when put in silo was as follows: first 2ft. wet with dew; next 4ft. sun-dried; and last 2ft. wet with rain. The first hamper when cut weighed 43lb.; the same hamper, when filled with whole grass weighed 38lb. This quantity took forty seconds to chop. If the grass were cut wet the weight of hamper would be 65lb. This day 370 hampers were filled in, and our average weight was 53lb., giving a total of 8 tons 16cwt. 1qr. 10lb. put in silo. In addition to this, salt was added at 1lb. to the cwt., 176½lb., or 1cwt. 2qr. 8½lb. Every tenth hamper of cut grass was weighed, The grass was cut into lengths from half to one inch. One man and two horses were employed in mowing; one man sharpening and assisting to fill carts; two men, carts, and two horses carting grass from field to silo; two men and two women in field


Surface of Ground
Manhole used for filling
Boxes filled with Bricks
Ensilage
NEW BRICKWORK
Archway from side of Bank by which Silo emptied
1 2 3 4 5 6 7 8 9 10 11 12 13 Ft.

raking and clearing ground and loading carts. At the silo, man driving engine; one man feeding chaff cutter, one man supplying him; three men treading cut grass in silo; one man spreading grass and salting; two men and one boy filling hampers and removing same from chaff cutter, weighing same, and also salt, and lowering all into silo. Stopped work at 7 p.m., 8ft. of grass having been put in silo, and weighed to 8 tons 16 cwt, 1qr. 10lb. During the day stopped three hours for meals, and the work all day proceeded only slowly, as all information had to be accurately taken, and much time was therefore lost. From 7 to 8 p.m. the weights were put on, after covering the surface with 1¼in. boards. The weights were thirty boxes, made of 1¼in. wood, with handles of rope, each box being 1ft. 10in. long, 1ft. 5in. wide, 1ft. 5in. high, and contained thirty bricks, each box and bricks being in weight about 2½cwt.; total weight, with boards, about 4 tons. 2½ acres of grass were mown this day.

July 5. Weights lifted out of silo in half an hour; mowing commenced at eight; first load of grass at silo at 8.20. This morning we found the ensilage had sunk during the night and with the weights a foot. Refilling therefore began at 7ft.; same mode of operation as before, 169 hampers, averaging 58lb., being put in silo, and giving a total of 4 tons 7cwt. 0qr. 18lb., which added to July 4 total, gives total weight of grass in silo 13 tons 3cwt. 2qr. Salt used this day 1lb. to the cwt. of grass—87lb., added to 176lb. put in on the 4th, gives a total of 263lb., or 2cwt. 1qr. 11lb. Mowing machine stopped at noon, and chaffcutter at 2 p.m.; 1½ acres mown this day; same number of hands employed at silo, but three extra hands in field loading grass; boards put on as before, afterwards 6in. bran, costing *3l.* *10s.*, and then the boxes of weights. Crops realised about 3 tons 1cwt. per acre, and if made into hay it would have realised about 15cwt. per acre. Total weight in silo — grass, 13 tons 3cwt. 2qr.: salt, 2cwt. 1qr. 11lb.; total, 13 tons 5cwt. 3qr. 11lb.

July 6. At noon grass level was 10ft., showing a sinkage of 2ft. 6in. On July 7, at 8.30 a.m., it was 9ft. 6in.; and on 14th it was 8ft. 6in., having then sunk 4ft.

July 27. Boxes of weights and bran cleared out of silo; mowing again commenced at 9.30; ensilage was found to be brown and quite sweet, though it was slightly warm; same mode of operation as before; grass mown, about 1¼ acres; weight put in silo, 3 tons 5cwt. 2qr. 6lb., and ½lb. salt to each cwt.—33lb.; 151 hampers, averaging 48lb. The first portion of the grass put in this day was quite dry, and the remainder strong and juicy, and damp with dew.

The total weight of grass now in silo was 16 tons 9cwt. 6lb.; salt, 2cwt. 2qr. 16lb., making altogether 16 tons 11cwt. 2qr. 22lb. The total acreage mown: July 4, 2½ acres; 5th, 1½ acres; 27th, 1¼ acres—5¼ acres.

COST OF FILLING SILO, TATTON PARK.

	£	s.	d.
July 4, 1883.			
One man driving, and hire of engine	0	13	6
One man feeding chaff-cutter	0	3	6
One man supplying him	0	3	6
Three men in silo treading and ramming	0	12	0
One man in silo spreading and salting	0	4	0
Two men and one boy placing and removing hampers, weighing grass and salt, and filling silo	0 0	1 7	6 0
One man and two horses mowing, and machine	0	15	0
Two men and two horses leading grass from field	0	14	0
Two men getting grass together in field	0	7	0
Two women raking, &c., in field	0	4	6
July 5.			
One man and engine	0	13	6
One man half a day feeding chaff-cutter	0	1	6
One man half a day supplying him	0	1	6
Three men in silo three-quarters of a day	0	6	9
One man in silo spreading and salting	0	2	3
Two men and one boy as above	0 0	1 4	1½ 6
One man and two horses mowing, and machines half a day	0	7	6
Two horses and two men carting	0	7	0
Two men loading grass field	0	3	0
Two women ditto	0	4	0
Three men ditto, and raking	0	4	6
29lb. cheese, at 8½*d.*, 1*l.* 0*s.* 6½*d.*; 56lb. bread, at 1½*d.*, 7*s.*	1	7	6½
36 gallons beer, at 8*d.*	1	4	0
July 27.			
Engine and driver	0	12	0
Four men in silo	0	14	0
Seven men in field	1	1	0
14½lb. cheese, 10*s.* 3½*d.*; 28lb. bread, 3*s.* 6*d.*	0	13	9½
Beer, 12 gallons	0	8	0
Mowing machine half a day	0	7	6
Total	£13	10	5½

When the silo was filled in July the side entrance was blocked up as already stated, but the side door was opened in February for the removal of the ensilage, which was cut with a hay knife, taken out in baskets, and portions of it handed round amongst those present, and a number of horses attached to the carriages and gigs were tried with it, and most of them ate it readily. To the depth of from six to nine inches it was clogged and mouldy, but the ensilage below was found firm, moist, and sweet, giving forth a pleasant odour. Owing to an unfortunate outbreak of foot and mouth disease in the neighbourhood, no cattle were on the ground; but, Lord Egerton's agent announced that for the purpose of thoroughly testing the nutritive qualities of the ensilage eighteen feeding bullocks of average size and quality had been set apart, and carefully weighed, half of which it was intended to feed with ensilage in addition to the ordinary corn and cake, and the remainder with hay and turnips in place of the ensilage.

SILO ON THE CREWE SEWAGE FARM.

On the recommendation of the Farm Committee, the Corporation of Crewe determined to test the value of the ensilage system for the preservation of fodder. Use was made of an old unoccupied building, which, after some alteration, was adapted for the end in view. Its internal dimensions are—length, 18ft.; width and depth, 12ft. The bottom is 9ft. below ground. The walls are of nine-inch brickwork, and the inside lined with cement. The bottom has been drained, and is formed of concrete. The operation of filling began on Aug. 14, 1883. The grass used was a second crop of Italian rye-grass in seed, and free from any moisture except its own sap. Twenty tons of grass were chopped and deposited. In the topmost layers 1cwt. of salt was sprinkled. The grass was then covered with $1\frac{1}{2}$in. boards, without bran or straw, and weighted with nine tons of stone, the pressure being about 120lb. to the square foot. In a week it had sunk a yard, and a few weeks later the silo was again filled to the top with chopped rye-grass and covered and weighted in a similar manner. A wooden roof protected the ensilage from rain.

On New Year's Day the silo was opened. The Mayor and most of the members and officers of the Town Council were present, accompanied by numerous visitors. After a careful inspection, it seemed to be the general opinion that the experiment had been highly successful. The discolouration only extended for a few inches from the top. The mass was perfectly sweet, and emitted an odour far from unpleasant. The only apparent effect of the use of the salt was that the portion in which it had been used seemed somewhat more humid than the rest..—*Crewe Guardian.*

MR. LOWE'S SILO, CHAPEL-EN-LE-FRITH, DERBYSHIRE.

A large number of landowners, farmers, and others were present at the opening of a silo on the premises of Mr. J. W. Lowe, Ridge Hall, Chapel-en-le-Frith, on Feb. 25. The silo is 27ft. long, 17ft. wide, and 10ft. deep, all above ground, being formed of the stone walls of a barn, coated with cement. About three weeks were taken in the filling of the silo, during intervals of haymaking, a few loads being put in every day, and no covering or weights applied until completed. Mr. Lowe explained that the ensilage was eaten greedily by his dairy cows, and also by the pigs. He said it was unnecessary either to chop the grass, to use salt, or to cover with bran, each of these being a needless element of expense. He weighted heavily with pig iron. Judging from his own experiences, he was quite confident that the system would eventually prove a grand success. He hoped landlords would construct silos for their tenants, as by doing so they would benefit their own interests as well. The farmers present expressed their opinion that the experiment was a substantial success.

TWO STAFFORDSHIRE SILOS.

Mr. Bourne, of Hilderstone Hall, near Stone, had a silo constructed in a Dutch barn. An excavation was made 31ft. long, 12ft. wide, and 12ft. deep. It was walled and double-bottomed with bricks and mortar, the sides and bottom being cemented. Being under a Dutch barn no roof was required. The cost of making it, including the planks to cover the ensilage, was 48*l.* 13*s.* The silo not being completed earlier, it could not be filled until July 31, by which time the crop had become older than it should be. It was chaffed until the spindle of the chaff-cutter broke, when three loads of long grass were put in to fill the silo. Planks were then laid over it, and heavy stones put on to the amount of 120lb. to the square foot. In fourteen days the grass sank 5ft. 7in., when the stones, planks, &c., were removed, the silo filled up, replanked, and weighted. This process was gone through a third time, after which strong planks were laid across the walls of the silo, and three corn stacks were built on them. One of the corn stacks having been threshed, this silo was opened on Dec. 18. The temperature on Dec. 24 was 56°. The sample of ensilage sent to me is good in colour, and has a vinous smell. The cows took to it from the first, and Mr. Bourne's bailiff writes: "We give the cows 60lb. each per day; they are very fond of it, and are much improved in themselves, as well as give more milk. One barren cow gives five pints per day more than she did with hay. We have tried the cart horses with it, and they seem as fond of it as the cows are. I am sure our silo will prove a boon both to them and our cows."

A silo was also made by Mr. John Bourne, a son of the gentlemen who built that mentioned above. A space 30ft. long by 15ft. wide, and 9ft. deep, was excavated in rocky marl on high ground. This cost 5*l.* Over this excavation a light wooden frame was covered with corrugated iron, at an expense of 6*l.*; the total cost therefore of making the silo was 15*l.* Mr. John Bourne commenced filling it with long grass in the beginning of July. It was three times filled up, and was finally closed at the end of that month. It was covered with 2in. boards, small spaces being left between them to emit the air. On the boards were placed soap boxes filled with marl, well pressed in, and placed so close together as to entirely cover the silo. The weight per square foot was 60lb. This silo was opened on Dec. 1, the temperature being 80°; the animals took to it readily. The sample sent to me was far above the average, and, after being in my room for more than a fortnight, still continues good. It was not so wet as the general run of ensilage, but its smell was, and still is, like very sweet hay. I look upon the silo as one of great interest, as it proves that first class ensilage can be in an inexpensive earth silo. No bricks and mortar, no masons' bill, no expenses beyond the excavation of the ground, and the erection over it of some cheap covering to throw the wet off.—From a letter by Major Fitzgerald (*Field*, Jan. 12, 1884).

THE EARL OF WARWICK'S PRIZE ENSILAGE AT THE DAIRY SHOW, 1883.

THE honour belongs to the British Dairy Farmers' Association of having first devoted a prize in London to the best sample of ensilage exhibited in competition. In doing this, the management have shown spirit and discernment, recognising the value of ensilage for dairy cattle. The silver medal at the Agricultural Hall has been awarded to the specimen sent to the show by the Earl of Warwick from Heathcote Farm, Warwick, through his farm manager, Mr. Tough, from whom I had a verbal description of the successful experiment which resulted in producing so excellent a specimen truss of ensilage, that would be fit and welcome to the cattle of any stockyard in the kingdom. The forage was sound, of good colour, and had the right appetising smell which should belong to properly-made ensilage, and which is altogether distinct from the rank, fetid effluvium that emanates from those foul masses of spoiled forage which sometimes pass under the name.

The Earl of Warwick's Exhibit, No. 702 in the catalogue, was made from second-cut clover and a mixture of rye grass, furnished by Messrs. Carter, of Holborn, for a two-years' lay; and here I may note that such a mixture of herbage and strong artificial grasses appears one of the most suitable for making into ensilage. The prize sample has *not* been chaffed. The ensilage exhibits attracted much attention and comment, and handfuls were asked for, to be sent off by parcels post.

The class for silos and ensilage, may be here given as a guide to other associations making up their prize list: "The entry must consist of a sample of ensilage (weighing about 56lb.) the contents of a silo being the property of the exhibitor; together with a model or drawing of the silo from which it is obtained, with a description of the method employed, time of harvesting, condition of season, &c., for insertion in the catalogue." Better terms than these could scarcely be put in a short paragraph.

The entry from the Earl of Warwick, had a rough but complete drawing of the silos, with written description. They were constructed out of an old barn, the walls of which were strengthened where required by buttresses, and cross walls were built in 14in. brickwork. Across one bay thus formed, a 9in. wall made the division. Thus three silos were formed, the undivided bay holding 45 tons ensilage, reckoning 40lb. to 2520 cubic feet; whilst the opposite bay, divided, would hold about half in each section. The centre of the silo would be the threshing floor of the barn. The interior walls were built 10ft. high, and cemented ¾in. thick. The large silo was floored with brick, the smaller silos had six inches of concrete in one case, bricks in the other. The large silo was filled in June with sewage-grown rye grass, and not yet opened. No. 3 silo was unfilled.

No. 2 silo was filled July 23, 24, in overcast weather, but with temperature at 70°, from a crop cut on the 23rd, and from this the prize sample was taken. On the first day 13 tons 7 cwt. of forage were put in; on the second day 5½ tons were added to fill the silo. The total weight of green clover was 18 tons 17cwt., and the cost (exclusive of horses) was 3*l* 12*s*. 3*d*.—for machine man, 2*s*. 7*d*.; three men loading, 6*s*. 7*d*.; four boys driving, 3*s*. 7*d*.; eight men treading 16*s*.; three women raking clover together, 3*s*.; labour in filling 13*s*.; two sacks bran to cover top, 12*s*.; ½lb. salt to each 1 cwt. of grass 1*s*. 6*d*.; beer, 9*s*.; labour in placing weights, 5*s*., which were 1 cwt. to square foot.—Invicta, in the *Field*).

Ensilage Feeding Experiment.

Sir,—All questions connected with the uses of ensilage have now so much interest for agriculturists, that I need not apologise for troubling you with the result of an experiment which has just been completed on the Earl of Warwick's Heathcote farm.

At this farm there is a dairy of fifty cows, and we were anxious to ascertain what effect a certain proportion of ensilage with their food would have upon the milk. In order to test the matter fairly, Mr. Tough, who manages the farm, selected two lots of four cows each. The milk from each cow had been weighed daily beforehand, and the cows were put in two lots, so that the total yield from each lot should be as nearly as possible the same.

The whole of the cows were receiving daily 40lb. of mangold pulped, and mixed with 15lb. of hay chaff, and 6lb. of palm-nut cake and bean flour mixed.

No. 1 lot were kept on this food for the three weeks the trial lasted.

No. 2 lot had from 20lb. to 30lb. of ensilage in the place of roots. This was the only difference.

We found that the cows on each ensilage varied a good deal in their appetite for it, some days eating 30lb. and others only 20lb.

No. 1 Lot.	Total Milk.	Percentage of Cream.	No. 2 Lot.	Total Milk.	Percentage of Cream.
First week ...	791½lb.	...... 59¾	First week ...	975lb.	 53
Second ,, ...	811½lb.	 56	Second ,, ...	994lb.	...... 51¼
Third ,, ...	767½lb.	...... 56¾	Third ,, ...	1000½lb.	...... 53¾

Samples of the milk were sent to Dr. Bostock Hill, of Birmingham, the county analyst, to test. He reports thereon :—

The following are the results of my analysis of the two samples of milk received:

	No. 1 Lot.	No. 2 Lot.
Solids, not fat	9·62	9·40
Fat	3·81	3·94
	13·43	13·34
Ash	0·76	0·72

Both samples are of excellent quality.

I may mention that the ensilage was made from rough meadow grass. It was put in long, with ½lb. of salt to the hundredweight. It came out in excellent condition. After several experiments, I prefer this proportion of salt to a larger one. The ensilage was chaffed along with the hay, which will be found to prevent the clogging of the knives, of which some have complained.

The trial promises well for the future of ensilage, and when the relative cost of this and roots is taken into account, the result is even more satisfactory than appears at first sight.

WM. T. E. FOSBERY,
Warwick, April 9, 1884. Agent to the Earl of Warwick.

MESSRS. TREPPLIN'S SILOS IN WARWICKSHIRE.

MESSRS. TREPPLIN farm something over three thousand acres, which for the greater part lie round the picturesque old ruin of Kenilworth. The land is split up into twelve holdings, the buildings of which are antiquated and decidedly inferior. It is necessary to mention this to show that the appliances which have here been used to produce ensilage are within the reach of any agriculturist. The Messrs. Trepplin, at a very small outlay, have utilised the present buildings to the best advantage. In 1883 they commenced to build three brick silos—two dug out of the side of slopes, and one erected against the end of a barn. In building one of the former they unfortunately dug to water, and, as time was pressing, the task was relinquished, and the hays and floors of the barns were requisitioned. Thus these gentlemen have preserved over *five thousand* tons of fodder.

At Villiers Hill the barn was filled with rough meadow grass, clover, and sewage grass, carried at different intervals, and in all weather, even when it was raining hard. The grass was not passed through a chaff-cutter, but unloaded into the silo as it came from the fields, the mowing machine going round the crops and the carts following it. The means adopted to prepare the barn for its contents were very simple. There were no drains inserted, nor was the floor, brick or soil, meddled with; in fact, nothing was done except to fill up the cracks in the walls where it was thought necessary. These were shored on the outside; but this was found to be unnecessary. Horses were used to tread the grass as it was thrown in. The grass was stacked at harvest time, and as it subsided was filled up again for a period of a week or more. Notwithstanding this it sank fully 5ft. after the weights (which consisted of boards and stones) were placed upon it for the last time. The side at one end was open, yet it presented no material difference from the sides close to the wall. There was but little mould apparent, certainly not an inch thick at the edge, about a couple of inches or more at the top, while the bottom appeared to be sound. That which had been carried wet was black, where

it had been carted dry it was brown, while some of the sewage grass was a faint green. The smell was by no means unpleasant, strong and vinous, and not sour. The mass was still hot and moist almost to wetness. Everything upon the farm partakes of ensilage, it being cut up into chaff with straw which somewhat dilutes its pungency of aroma and renders it most appetising. Mr. Trepplin states that the feeding stock on first being brought in from the fields were greatly given to scouring, a complaint which ensilage has entirely eradicated.

At the East Chase farm was perhaps one of the best samples of ensilage. It was clover of a light brown colour, and appeared to be very sweet. It was in the bay of a barn and had been subjected to great pressure. The front was left bare; but the top had been covered with loose sand. There was very little mould observable. The other side of the barn was occupied with more ensilage, but in this case no pressure had been resorted to beyond that which the filling necessitated. Yet the mass had sunk eight feet. It was merely covered up with straw, though the side which under ordinary circumstances would have been bare was boarded up. On trying to get a sample from the top we found a few inches had rotted. Underneath was a faint green coloured sample, of good odour. This was meadow grass, and was ricked early in September.

At the Fernhill homestead the thrashing floor of the barn had been filled, together with the bays, and a section was cut from the doors; consequently one side had been exposed to the air for nearly a month. This had rotted to the extent of a few inches, but beyond that was perfectly sound, and although quite black was eaten. It was clover got in July, and carried on some of the most rainy days. Nevertheless even in this state the part exposed to the air will not decompose or become mouldy for quite a week.

At Goodrest there was just a truss left on the threshing floor of the barn. This was meadow grass gathered in September. It had had no pressure placed upon it, and was, as the sample under similar conditions above, of a faint green colour. Even this small portion still retained its moisture, and was highly scented.

Mr. Trepplin has demonstrated that many a crop of grass which in September is practically worthless, and which more often than not is trodden into the ground, can with little labour be converted into valuable fodder. In his case no expensive silos have been erected, but the ordinary buildings of every farm have been found sufficient for the purpose.

Messrs. Trepplin milk two hundred cows and they are all fed with ensilage, as also are the cart horses. Their condition testifies that it does not disagree with them, but as said before it is given them with straw as chaff.

[The above is condensed from a long article in a local journal, the name of which was not mentioned on the extract sent to us. A question having been asked in *The Field* as to the ensilage made without being weighted, Mr. C. Trepplin replied that, "The herbage was short grass,

cut in September, in meadows shut off late. Being carried damp, it settled down quickly, and, after being covered with some old hay or a few boards, it turned out as good as the ensilage made in the summer and weighted heavily."—Ed.]

LORD FITZHARDINGE'S SILOS AT BERKELEY.

Lord Fitzhardinge and a large company of gentlemen and tenantry assembled on Dec. 12 at the home farm, Berkeley Castle, to witness the opening of one of three silos which his lordship has had constructed. The silo was built of brick in a barn, cemented inside; it is 12ft. 3in. long, by 7ft. 6in. wide, and 10ft. 10in. deep. On June 9, 15 tons of newly-mown grass was cut up with the chaff-cutter and placed in the silo, 2lb. of salt to the cwt. being added, and sprinkled over the grass as it was being put in. This was closed up till Aug. 13, when it was opened and filled up with 12 tons of clover, put in green in the same way as the grass. It was then planked on the top and pressed down by placing 2 tons 12 cwt. of bricks on the top (about 63lb. to the square foot), after placing a layer of bran all over to keep it free from air, and was not opened till Wednesday. On being cut, the top layer of the ensilage was found to have a strong and very unpleasant odour, but lower down where the density of the ensilage had increased, the unpleasant odour diminished. With this exception it was perfectly fresh. Mr. J. Peter, the farm steward, gave some to the cows, who ate it freely, but the horses would not eat it. A good many expressions of opinion were given both in favour of and adverse to the use of ensilage.—*The Farmer.*

At a meeting of the Gloucestershire Chamber of Agriculture, on Jan. 12, 1884, Lord Fitzhardinge said he believed he was the only person in the county who had carried out the system of ensilage, and he read a short report of the results. The food of the dairy cows had been varied, ensilage being given with and without dry hay chaff and certain quantities of oatmeal, and records kept of the yield of milk. The result appeared to be that there was little, if any, difference in the quantity of milk produced; but his lordship said the cream was a good rich colour, and the butter excellent, when the cows were fed on ensilage.—*Live Stock Journal.*

MR. CUNARD'S SILO, NEVILL HOLT, MARKET HARBORO'.

Mr. Cunard had a silo formed by walling off a portion of an old barn, and cementing the inside. It was filled with clover, carried immediately on its being cut, chopped up with a chaff cutter, and mixed with 2lb. of salt to every 1cwt. of grass. After being well trodden down, shutters were put on the top, and weighted with large blocks of stone. When opened in January it was in good condition, and the beasts ate it greedily.

LORD WALSINGHAM'S SILOS AT MERTON.

[IN the Wayland Hall, Watton, Norfolk, on Feb. 5, 1873, Mr. Henry Woods, of Merton, delivered a lecture on "Ensilage: its Origin, History, and Practice," * to a large assemblage of landowners and tenant farmers. After speaking on the origin and history of the process, and what had been done in other countries, and in various parts of England, Mr. Woods related what had occurred within his own experience:]

IN the month of July, 1881, we had a small silo constructed on the ground floor of a granary. Its internal measurements were 8ft. 4in. long, 4ft. wide, 4ft. 4in. deep. In August we made our first experiment, which was a sharp and trying one. The chaff with which I experimented was made in equal parts from second-crop red clover and rank-grown succulent grass, cut from a pasture which had been heavily folded with cake-fed sheep. The grass and clover were both cut and carted in a drizzling rain. The chaff when made was at once put into the silo. It was salted at the rate of 1lb. of common field salt to 1cwt. of grass chaff, and was trodden down as firmly as possible. A layer of salt, in thickness about an inch, was placed on the top of the mass. It was covered with two wood shutters, upon which we spread a layer of bran, 9in. in depth. The whole was weighted with large stones, weighing together about three-quarters of a ton. After the lapse of about three months we opened our little silo. We found some of the contents to be useless. The upper portions of the ensilage, to the extent of a third of a foot, were in a state of decomposition, and unfit for feeding purposes. Decomposition was also at work at the bottom of the silo. Its extent was some four or five inches, But beyond these upper and lower layers, although so wet that water could be squeezed out of it very easily, the chaff was quite green and fresh, and had a strong aromatic and acid-like smell. At the outset the cows when offered the food did not take kindly to it; but in the course of two or three days they manifested a fondness for it, and ate it freely. Our success was only partial; but other experiments, on a much larger scale and somewhat different plan, were arranged, and we determined to profit by the lessons of our first trial.

We converted one bay of a clay-built barn, at Merton, into silos. Across the bay front we put up a 14in. brick wall to within 3ft. 10in. of the tie beam, and two division walls of the same description, which gave us three silos, each 14ft. 4in. in length, 6ft. 3in. in width, and 9ft. 3in. in depth. The barn floor was laid with asphalte some years ago, and therefore the silos required no new bottom. We covered the walls with cement plaster, composed of Portland cement and well-washed road silt, in the proportion of three of cement to one of silt. This coating, which was

* This lecture has since been published with additions, and plans of the buildings, by Messrs. Stevenson and Co., Market Place, Norwich.

about half an inch in thickness, answered well in every respect, and showed, I think, that even clay-built barns are easily convertible into good silos. To prevent the brickwork being displaced in the filling process, a $2\frac{1}{2}$in. plank, 14in. wide, was properly secured to the wall tops, and to facilitate the emptying of the silos a well-made $1\frac{1}{2}$in. boarded door, protected by a coating of hot tar and pitch, was inserted in one corner of the front wall of each silo. The frames of the doors were set on the inside, so that the doors opened inwards to the partition walls, and the apertures were hermetically sealed by means of 4in. brickwork on the front sides. The total cost of these three silos did not exceed 30*l*.

It was my serious intention that the experiments we made should not err on the side of leniency. With this object I used coarse common grass for the test. (Referred to in the Analysis as No. 1.) Two of the silos I directed to be filled with grass taken from an oak wood, known as Merton Wood. For some years I was in the habit of giving the grass to any respectable person who liked to cut it for litter. During the past few years no one has cared to have it. They have said, "It is such poor stuff, if it once gets wet after being cut there is little chance of getting it dry again; it is then useless even as litter." You may therefore conclude that if the ensilage system, when applied to grass of this coarse and common character, has been at all successful, much greater things are to be gained from a finer and better sort of material. The ensilage in the third silo, I may add, was from grass grown in a rough meadow. (Referred to in the Analysis as No. 2.)

The silos were filled uninterruptedly, in the course of three or four days, early in July. Although the weather was dull and sunless, there was no rain. The grass was loaded on to waggons as it was cut, and conveyed direct to the chaff-cutter. Amongst each cwt. of chaff 2lb. of common field salt was distributed.* Let me here say, once for all, that a great deal depends upon the treading and ramming process. The more effectually this is done the better will be the ensilage. When the silos were quite filled, the chaff having been as well-trodden and rammed down as possible, the contents were covered with wood shutters, and over these we spread a bed of coarse bran, about eight inches deep. For weights we used a lot of clean flint stones, in wicker skeps, which cost a shilling apiece, and which will last for years before requiring to be renewed. The pressure, which we carefully distributed over the whole surface, was little more than a ton and a half in each silo, which contained about fourteen or fifteen tons of cut grass. Three weeks after the filling of the silos the ensilage had shrunk to about a third of its original depth. We then removed the weighted baskets and bran covering, again filled the silos to the top, and replaced the boards, bran, and skep-weights. Little labour and no difficulty attended this operation. The skeps were lifted on to the partition walls, while the bran was put temporarily into sacks. An accurate and detailed account of all the expenses incurred for the filling

* Mr. Woods has since reduced the salt to about $\frac{3}{4}$lb. per cwt.

was kept by the farm bailiff. The amount did not exceed 8*s*. 6*d*. per ton, or 12*s*. 9*d*. per acre, the crop averaging about one and a half tons per acre. There was but slight heat, and no mouldiness visible when the shutters were removed to refill the silos; and it is also a fact worthy of notice that in the ensilage now used from them there is nothing to indicate where the later filling began. With regard to the cost of making ensilage of grass, as compared with that for the same weight of hay, we had no actual data to guide us to a definite conclusion. But I was desirous of getting some reliable practical estimate, and through the kindness of Mr. W. Biddell, M.P., of Lavenham Hall, Suffolk, and Mr. T. Gayford, of Wretham, Norfolk, gentlemen of great experience and ability as valuers, I have received particulars which enable me to state that in an average season the cost of making one and a half tons of grass into hay, stacking, and afterwards cutting into chaff, is from 25*s*. to 26*s*. per acre. From this it will be seen that our ensilage was produced at a saving of 50 per cent. on the cost of ordinary haymaking and chaff cutting.

Five months elapsed (Dec. 11) before we opened No. 1 silo. On removing the covering the thermometer registered 61°. This temperature obtained to a depth of about two feet, when there was a considerable fall, and still lower down it was quite cold. We fetched the ensilage over the top, until we had cut down a section sufficiently large to admit of the sealed door being opened; after which it was carried out through the doorway in the usual manner.

Now, as to the quality of the ensilage. The grass we packed was very inferior to that used for the small Trial Silo in 1881-82; yet there was such a marked superiority in the quality as to strike all of us with surprise. This improvement I attribute to three causes, viz.—not having cut or carted the grass in a wet state; using about 2lb. of salt instead of 1lb. to each cwt. of grass; not putting a layer of salt beneath the shutters before closing the silos. This year the ensilage is nicely moist; but no water can be squeezed from it, and it is quite free from mould. When first given them, the horses, cows, and young stock ate it readily, and have since continued to do so. The horses, to which we give one-third ensilage to two-thirds chaff, are doing remarkably well.

Value of Ensilage for Dairy Cows.

In order to ascertain the effect of ensilage on the cows, Lord Walsingham suggested, shortly before opening the silos, that the milk and cream, before and after the ensilage feeding, should be carefully tested, and the results tabulated. For this purpose I selected five pedigree shorthorn cows, which dropped calves on July 27, Oct. 27, Nov. 24, and two on Nov. 30, 1882. Previous to giving ensilage, each cow was daily fed with 6lb. of crushed oats and 3lb. of bran, mixed with chaff (composed two-thirds of barley straw and one-third hay). The five animals yielded, on Dec. 10, 68 quarts of milk, which the lactometer showed contained 12 degrees of cream. We commenced feeding with ensilage on Dec. 11,

and the following tables give the daily diet and yield from Dec. 14 to Jan. 10. Besides the proportions of ensilage and chaff, the oats and bran were given as before in each instance.

⅓ Ensilage, ⅔ Chaff.			½ Ensilage, ½ Chaff.			⅔ Ensilage, ⅓ Chaff.			¾ Ensilage, ¼ Chaff.		
Date.	Milk.	Cream.	Date	Milk.	Cream.	Date.	Milk.	Cream.	Date.	Milk.	Cream.
1882.	Qts.	Deg.	1882.	Qts.	Deg.	1882.	Qts.	Deg.	1883.	Qts.	Deg.
Dec. 14	70	13	Dec. 21	71	14	Dec. 28	72	15	Jan. 4	78	16
„ 15	70	13	„ 22	70	14	„ 29	72	15	„ 5	80	16
„ 16	70	13	„ 23	70	14	„ 30	74	15	„ 6	80	16
„ 17	70	13	„ 24	71	14	„ 31	74	15	„ 7	81	16
						1883.					
„ 18	70	13	„ 25	70	14	Jan. 1	76	16	„ 8	82	16
„ 19	70	13	„ 26	70	14	„ 2	76	16	„ 9	82	16
„ 20	70	13	„ 27	71	15	„ 3	77	16	„ 10	82	16

I will be observed that on Dec. 14, three days after the ensilage was first given, the milk had increased by two quarts with a rise of one degree in the cream. This went on until the 20th. On the 21st the cows gave seventy-one quarts of milk with fourteen degrees of cream, the latter showing another rise of one degree. On the 22nd and 23rd, and the 25th and 26th, they seem to have fallen back to the extent of a quart of milk per day, which was probably owing to the cold wet weather which we experienced at that time; but, on the 27th, the lost quart was recovered, the supply again reaching seventy-one quarts and the cream making a further advance to fifteen degrees. The quantity rose on the 28th another quart (seventy-two quarts), and on the 30th and 31st seventy-four quarts were registered, with no change noted in the state of the cream. New Year's day brought us seventy-six quarts and sixteen degrees of cream. On Jan. 4 another quart was gained; on the 5th and 6th eighty quarts were given; on the 7th, the return rose to eighty-one quarts: and on the 8th to eighty-two; these figures continuing to be recorded down to Jan. 10, when the test ended, and when the greatly improved quality of the cream had undergone no change. When the month's trial concluded we had raised the milk return by fourteen quarts per day, and the quality of the cream to the remarkable extent of four degrees. The tables also show that the increase in the quantity of milk and improvement in the quality of the cream correspond with an increased amount of ensilage given to the cows.

Milk Analysis.

We were naturally anxious to test the quality of our ensilage milk by analysis, and on Jan. 9 we sent two samples to Mr. Francis Sutton, F.C.S., of Norwich, who, besides holding the position of County Analyst, is Analyst to the Norfolk Chamber of Agriculture, and whose high attainments are so widely known that I need not say another word about his

qualifications. No. 1 sample was the milk of cows not ensilage-fed; No. 2 came from the five cows, the subjects of the test. The following is Mr. Sutton's report:—

	No. 1.		No. 2.
Pure fat	2·76	....	3·11
Sugar, casein, albumen, &c.	9·37	....	9·82
Water	87·87	....	87·07
	100·00	....	100·00
Mineral matters (ash)	0·70	....	0·75
Specific gravity at 60°	10·30		10·32

This analysis, you will observe, is in favour of the No. 2 (ensilage) milk in every respect. Whilst in pure fat there was an increase of 0·35, and in sugar, casein, albumen, &c., of 0·45, there was a decrease of ·80 water. Mr. Sutton also writes to me as follows: "From my examination of the ensilage, so far as it has now gone, I should be quite prepared to believe in its value as a milk-producing food owing to the great proportion of soluble nutrition in it. These results have fairly surprised me, and when you get them I feel sure they will have the same effect upon yourself."

It is a striking fact, not to be passed over, that two cows which had been fed with ensilage, on being deprived of the food for a couple of days, gave three quarts of milk less each day.

Analyses of the Ensilage.

As to the constituent properties of our ensilage, it would be beyond the province, and also the competency, of a layman to speak. Lord Walsingham, gratified as he might well be with the milk-pail returns of the cows, was extremely anxious to get as full and exhaustive analyses of the ensilage as possible. We therefore sent two sets of samples of the food to Mr. Sutton, and samples of hay made from grass of the same description as the ensilage, for the purposes of comparison. The first set (Nos. 1) consisted of ensilage made from grass, which I have described as grown in the wood, and hay from the same kind of grass. The second set (Nos. 2) comprised ensilage made from the coarse grass grown in the meadow near the wood, and hay made from grass cut in the same meadow. The results of the analyses are set out in the following table:

General Composition—Natural State.					Dried at 212° Fahr.			
	Hay No. 1.	Hay No. 2.	Ensilage. No. 1.	Ensilage. No. 2.	Hay No. 1.	Hay No. 2.	Ensilage. No. 1.	Ensilage. No. 2.
Water	22·20	24·90	74·30	65·95				
Soluble organic matter	8·21	9·75	6·24	9·17	10·55	13·00	24·28	27·00
Soluble inorganic matter	4·05	3·15	1·78	1·88	5·20	4·20	6·92	5·55
Insoluble organic matter	61·04	58·50	16·91	22·18	78·50	77·85	65·80	65·05
Insoluble mineral matter	4·50	3·70	0·77	0·82	5·75	4·95	3·00	2·40
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Detailed Composition—Natural State.					Dried at 212° Fahr.			
Water	22·20	24·90	74·30	65·95				
Albumen and protein substances soluble in water*	0·73	0·88	1·60	2·12	0·94	1·17	6·22	6·23
Insoluble protein compounds†	5·03	7·09	1·41	1·43	6·46	9·45	5·49	4·20
Sugar, gum, and extractive matter soluble in water	7·48	8·87	4·64	7·05	9·61	11·85	18·06	20·73
Oil, wax, and chlorophyll, &c.	1·29	1·34	0·72	0·89	1·54	1·80	2·80	2·60
Digestive fibre	20·80	19·80	8·28	10·62	26·73	26·35	32·24	31·17
Indigestible woody fibre	33·92	30·27	6·50	9·24	43·74	40·25	25·26	27·14
Soluble inorganic matter	4·05	3·15	1·78	1·88	5·20	4·20	6·93	5·53
Insoluble mineral matter	4·50	3·70	0·77	0·82	5·78	4·93	3·00	2·40
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
*Containing nitrogen	0·115	0·140	0·255	0·336	0·149	0·186	0·992	0·990
†Containing nitrogen	0·795	1·120	0·221	0·226	1·020	1·490	0·860	0·665
Total percentage of nitrogen	0·910	1·260	0·476	0·562	1·169	1·676	1·852	1·655
Equal to total protein compounds	5·760	7·970	3·010	3·557	7·400	10·63	11·72	10·47

I take it that the satisfactory nature of these results is plain to the meanest capacity. But Mr. Sutton has rendered us, and I may say the whole agricultural community, essential service by appending a singularly lucid and able report to his analyses. The importance of his conclusions, in their probable bearing upon the ensilage controversy, could scarcely be over-rated. As to what those scientists who have formed hasty and dogmatic opinions upon confessedly insufficient data may have to say to it, and how far they may hereafter be constrained, by the hard logic of facts, to modify their views, we have nothing to do. They are matters into which it is not needful, nor would it be profitable, for us to enter now. In giving publicity to this report, all I would venture to observe, by way of note or comment, is that my practical experience in the management of live stock, extending beyond a generation of time, thoroughly confirms what Mr. Sutton has so intelligently expressed.

"REPORT ON THE ANALYSES OF HAY AND ENSILAGE.

"County Analyst's Office, Eastern Counties Laboratory,
London-street, Norwich, Jan. 17, 1883.

"The two samples of hay consisted of a variety of grasses, many of them of a coarse description and of poor quality, and were destitute of the sweet smell and taste which always accompanies well-made meadow hay of good quality.

"The texture of No. 2 was, however, preferable to No. 1, and the grass of a somewhat finer description.

"Both specimens of ensilage were, on the contrary, highly odoriferous from the development of the essential oils peculiar to the various grasses, and had also a vinous smell accompanied with a slight but pleasant acidity.

"The smell of essential oils was so persistent that after handling the ensilage for some time it became very difficult to remove the smell by washing. On distilling some of the material with water, these essential flavours were carried over into the distillate, but, though powerful, the quantity of actual oil was too small to be separated.

"The hay treated in precisely the same manner gave no trace of essential oils, or any flavour whatever except that of decaying grass.

"In addition to the detailed analyses recorded in the tables, the ensilage Nos. 1 and 2 were both examined for the amount of acidity; this was found to be very much the same in both samples, and, taking it as acetic acid, the proportion was found to be respectively 0·34 and 0·36, or about one-third of a per cent.

"The alcohol was estimated in No. 2 ensilage, and amounted to 0·055 per cent. by weight, or about one-tenth of a per cent. of proof spirit.

"These proportions are very small, and they arise, of course, from the conversion of a small proportion of saccharine matter in the original grass, but their development is open to no objection when kept within moderate limits; on the contrary, they add to the fragrancy and taste o the substance, and undoubtedly render it more acceptable and probably more digestible as a food.

"If the effects of the silo were only to render what would otherwise be a tasteless, dry forage into a fragrant, appetising, and succulent food it would be a decided step in advance; but the analyses will show tha much greater changes of a beneficial nature occur during the process. These changes are especially shown in the large proportions of soluble flesh-formers and fat-producers as compared with the hay.

"For instance, in the case of No. 1 ensilage, the soluble albumenoids (or flesh-formers) are increased more than six times, and in No. 2 more than five times; while, in the case of sugar, gum, and extractive matters, the proportion is nearly doubled in both instances. The digestible fibre is also increased fully 20 per cent. in both samples of ensilage.

"These facts are of great importance, and well worth the attention of all stock feeders, as it is evident that the occurrence of these nutritious constituents in a really soluble form is so much labour of mastication and digestion saved to the animals who are fed on such food, as compared with dry hay.

"The change induced by the silo is, in fact, a partial digestion or limited fermentation; and undoubtedly such food will prove much easier of digestion and assimilation than crude hay.

"There are apparently two anomalies in the figures of analysis which it may be proper to notice. The first is the apparent increase in fatty matters in the ensilages as against the hays; this probably arises from matters like chlorophyll, &c., which are converted into a less soluble form in the process of drying through which the hay has passed. The second is the amount of nitrogen in No. 1 ensilage as compared with its hay.

"The total protein compounds (flesh-formers) are recorded as being 4 per cent. higher. This can hardly be the fact, as, of course, the silo has no power to originate nitrogenous constituents; it can only modify them. The difference probably arises from one of two things—either that the sample of ensilage taken for analysis contained rather more of the seed vessels or other richer nitrogenous portions of the plant than the corre-

sponding sample of hay, or it may be due entirely to the different periods of growth.

"In conclusion, it is abundantly evident, so far as these analyses can show, that the silo has produced a succulent, easily digestible food, full of aroma and nutrition, from a very poor quality of grass.

"FRANCIS SUTTON,

"Chemist to the Norfolk Chamber of Agriculture."

A TRIAL WITH EWES.

[A few weeks later Mr. Woods sent the following letter to the *Field.*]

Desiring that the independent opinion of some reliable person should be obtained as to the effect of the ensilage on in-lamb ewes, I induced Mr. Thomas Gayford, of Wretham, near Thetford, who is widely known as a thorough man of business and as an eminently practical flockmaster, to undertake a trial on ten ewes, which were, with one exception, taken indiscriminately from a lot which had been selected from the general flock because they were low in condition. The ewe which formed the exception referred to was a notoriously bad milker, and it was desired to see what effect the ensilage would have on this particular ewe.

I am glad to be able to report that the result of the trial has been most satisfactory; and I venture to think that it would be almost impossible, judging by the facts elicited by Mr. Gayford's experiment, to over-estimate the importance of ensilage to flockmasters, and particularly in a severe winter, or in a late sterile spring, when ewes urgently need a succulent, palatable food. Writing one day last week, Mr. Gayford says:

"The effect of the ensilage food on the milk of the ewes is most decided. The two which first lambed were (to use the shepherd's own words) 'smothered with milk'; and another, which I examined just after she had lambed, had a famous bag; and the milk was as golden in colour and as rich looking as if it came from the udder of a fresh-calved Alderney cow. The remainder of the ewes under trial all did well, and it is particularly noteworthy that the ewe which had always given so little milk on her previous lambings improved so much under the ensilage food as to give as much milk as any ewe in the general flock fed in the usual way.

"The extremely satisfactory result of feeding the ten trial ewes on ensilage, as regards their milking condition, has made me, as a flockmaster of thirty years' standing, to feel what a boon this new food will undoubtedly prove to be to flocks of breeding ewes on large tracts of light land in the eastern counties, and doubtless in other counties also. The large quantity and rich quality of the milk of the ewes under trial, after the past exceptionally mild winter, surely indicates how great will be the value of ensilage in a severe winter, when we are at our wits' end to procure a minimum supply of succulent food for our ewes. I have known many winters and springs when there has been unavoidably heavy loss and expense incurred from the impossibility of providing any succulent food, and until now nothing has been found to supply this indispensable

requirement for nursing ewes. It appears to me that this introduction of ensilage comes most opportunely, for never, during the present century, has the success of light-land farming depended so much upon sheep as now, nor have sheep ever been of more, if of so great, value."

With regard to the financial side of the question, my practical correspondent writes: "When the fact is generally understood that ensilage can be secured at about two-thirds of the cost of hay, that its production is almost wholly independent of the weather, and that the grass on the parts of the fields near the fences may be converted into ensilage, leaving the better drying portions and centre for hay, surely it will be true wisdom for flockmasters at least to give the matter a fair trial during the coming season." On the cost of silos Mr. Gayford adds: "I was talking yesterday at Bury St. Edmunds market with a very practical man, who held, like many others, the erroneous idea that silos must be made either underground, or with very strong thick walls to withstand the swelling from the supposed fermentation. This is one of the errors that lead farmers to suppose that silos are extremely costly in their construction, and the more widely your pamphlet is read and this nonsense dispelled, the better."

Seeing that breeding sheep are the sheet anchor of the light-land farmers, that it is only on these they can rely with any hope of success in these most disastrous times for agriculture, the foregoing testimony of such an experienced flockmaster to the merits of ensilage as a succulent food for sheep seems to me to be of great importance.

Merton, Thetford, Norfolk, March 20, 1883. HENRY WOODS.

On Monday, March 17, 1884, a lecture was delivered by Mr. H. Woods, at South Kensington Museum, on the influence of ensilage on British agriculture. The lecture, which was one of a series arranged by the Council of the Institute of Agriculture, was honoured by the presence of H.R.H. the Prince of Wales, who took the chair on the occasion. After some remarks on the depression of the agricultural interest, and the ever-increasing importation of wheat from foreign countries, the fact that the poor lands now going out of cultivation were growing nothing but coarse grasses that could only be profitably utilised in the silo was insisted on, Mr. Woods stating that the grass from under the trees in an oak wood, which in the recent state was useless as food for either horses, cattle, or sheep, made excellent ensilage, which was advantageously used for milch cows in November. The employment of a movable super silo 30in. in depth, to obviate the necessity for re-opening the silo to make good the loss of bulk through shrinkage, was described. And a great reduction in the amount of salt originally advocated by Mr. Woods was now insisted on. The lecturer still advocated the employment of bran as a covering to boards placed on the ensilage. The amount of weight used at Merton was stated to be 70lb. to the square foot,

being applied by means of boxes filled with gravel, each box being 24in. by 10in., and 18in. in depth. These hold about 2cwt. of stones, The desirability of chaffing the materials employed was strongly urged by the lecturer.

With regard to the relative value of ensilage and hay, the following were the remarks of the lecturer: "To test the relative weight and value of grass as ensilage and hay, we put into the silo an acre of heavy meadow grass. It weighed 12¾ tons and produced 12 tons of ensilage. An acre of the same made into hay weighed 2 tons 7cwt. Take the value of the ensilage at 1*l.* 6*s.* 8*d.* per ton, only one-third the value of hay, which I am aware is much too low an estimate, but I have adopted it in this and the other calculations which I am about to bring under your notice, being desirous of keeping well within the mark and of allowing, beyond all question, a margin sufficient to meet any possible contentions on the part of sceptics; then deduct the incidental expenses, including an allowance of 6*l.* 12*s.* 4*d.* per cent. on the cost of building a silo, and of 35*s.* an acre for rent and tithe, together amounting to 5*l.* 4*s.* 9*d.*, and we have a balance to our credit of 10*l.* 15*s.* 3*d.* Deducting from the return of the 2 tons 7cwt. of hay (valued at 9*l.* 8*s.*) 3*l.* 8*s.* 2*d.* for mowing, making, stacking, chaffing, and rent and tithe, we have a net balance of 5*l.* 19*s.* 10*d.*, showing a sum of 4*l.* 15*s.* 5*d.* per acre in favour of the ensilage as against the hay."

In the case of buckwheat, the balance was regarded as 2*l.* 8*s.* 3*d.* per acre in favour of the ensilage. In the case of green oats cut in July, the balance in favour of the ensiled crop, was regarded as 4*l.* 19*s.* 11*d.* per acre in excess of the grain and straw if harvested when ripe. The cultivation of spurrey as an ensilage plant for light sandy soils was strongly insisted on as being adapted for soils which are otherwise perfectly sterile, not growing either grass or clover.

Spurrey (Spergula arvensis) is an annual plant of the pink family (Caryophyllaceæ), and is largely cultivated in different parts of the Continent. It yields a rapid crop of succulent herbage. When ripe, the pods burst, and shed a great number of black seeds, which are said to be equal in nutritive value to rape cake. These seeds are bruised and given to horses and milch crows, and have the effect of increasing the quantity and improving the quality of the milk. Abounding on inferior light soils, the plant is greedily eaten by sheep and cattle, and is described as an eminently nutritious herbage, yielding a better pasture than red or white clover; the cows giving more and better milk. The experimental crop of spurrey at Merton yielded most excellent food for sheep and cattle, although grown on blowing sand, so poor that its cultivation had been abandoned. When cut it yielded 5¼ tons per acre, and produced such excellent ensilage that 120 acres are to be grown this year. The seed cost 45*s.* per cwt., which is at the rate of 5*s.* 10*d.* per acre; and the total expenditure per acre on account of seed, cultivating, ensiling, and

all other incidental expenses, including interest on silo building, amounted to 2*l.* 8*s.* 6*d.* In its natural state the spurrey weighed $5\frac{1}{4}$ tons, and when ensiled 5 tons per acre. On the already adopted basis of one-third the value of hay at 4*l.* per ton, it produced 6*l.* 13*s.* 4*d.* per acre. Deducting the incidental expenditure, allowing for rent 3*s.* (the price at which the land, now unlet, was valued to a tenant some years ago), the net profit amounted to 4*l.* 4*s.* 10*d.* per acre.

The utility of maize ensilage, and its high value as compared with swedes was then insisted on. A test of the relative feeding value of maize compared with swedes showed important results. The trial made with two cows extended over a month. One cow had a daily allowance of 42lb. of ensiled maize, with 10lb. of straw chaff, 8lb. of maize meal, and 2lb. of bran, and the other precisely the same allowance of food, except that 70lb. of swedes were substituted for the ensilage. While in the former case the supply of milk rose from a daily average of $11\frac{1}{2}$ quarts to 14 quarts, and the cream from 11° to $13\frac{3}{4}$°; in the latter case the increase of milk was only from 11 quarts to $12\frac{1}{6}$, and the cream from 11° to $12\frac{1}{2}$°. The ensilage-fed cow also gained 4st. in weight, the other but 2st. A similar improvement in condition having been noted in the case of the other cows fed with ensilage, the bailiff reduced their daily allowance of maize meal by 2lb. each. Equally satisfactory evidence was given of the suitability of ensilage as a food for sheep.

The employment of cask-made ensilage for cowkeepers in town and on ship board was recommended. A 60-gallon cask will contain 31st. of ensilage; a quantity sufficient, with a little hay or chaff, and maize meal, to feed a cow nine or ten days, and the animal would require much less water than when fed on dry food—a most important consideration on board ship.

The complete lecture, together with analyses, &c., has since been published by Messrs Hamilton, Adams, and Co., Paternoster-row, London.

MARQUIS OF BRISTOL'S SILO, ICKWORTH, SUFFOLK.

THE silo was built with 14in. brickwork, with piers and stout oak planks, and iron rods to prevent the building from bulging by lateral pressure. It is in two compartments, each 18ft. long, by 9ft. wide, and 10ft. deep; rendered inside by Portland cement $\frac{3}{8}$in. thick, and the floors are concrete rendered with Portland cement $\frac{1}{2}$in. thick. It was filled on July 19 and following days with rough grass cut into $\frac{3}{4}$in. lengths. The grass was very wet, as it was raining heavily at the time. It was rammed down close by manual labour, covered with 6in. of bran, and weighted by planks upon which bricks were laid. The doors were closed and bricked up with 9in. brickwork on July 23. Salt was applied in the proportion of 1lb. of salt to 1cwt. of grass. On being opened on Jan. 18, there was no mould, with the exception of a very small quantity by one door-post, and the mass of ensilage appeared in an excellent state.

THE DUKE OF HAMILTON'S SILOS AT GREAT GLENHAM.

THE Pound Farm, consisting of about 320 acres, is hired and literally worked, in so far as giving orders and finding the money are concerned, by the Duchess of Hamilton. Two silos have been built; one was filled in the early part of the summer and the other in September, the former being first opened. A field had been laid down with rye-grass, clover, and a few other seeds. The crop was carted direct to the barn, cut into chaff, placed in the silo forthwith, and rammed down with wooden rammers, 1½lb. or 2lb. of salt being added to each cwt. of stuff. When feeding experiments were commenced the results were eminently satisfactory. The cattle ate ensilage greedily, mixed with beet-root. The corn with which they had been previously fed was taken off, and the animals have since thrived on this ensilage, apparently none the worse—on the contrary, if there is any difference it is for the better. Mr. Smith found the quantity of salt excessive, the tendency being to cause the animals to drink too freely, and it is his intention to reduce the quantity of salt in future.—*Ipswich Journal.*

COLONEL TOMLINE'S SILO, ORWELL PARK, SUFFOLK.

MR. HENRY WOODS, in his Norfolk lecture, gave the following particulars of Colonel Tomline's silo: "In the early part of 1882 a silo, 26ft. in length, and 12ft. in width and height, was built under the side of a hill, with an opening at each end; one for filling, on the ground level, and the other for extracting the fodder. The walls and floor were of concrete (the former a foot or more in thickness). In July, the produce of eleven acres of oates, in the green state, was passed through the chaffcutter, and stored in the silo; eight men being engaged in the work, which was carried on in showery weather, and completed on Aug. 12. The covering consisted of three loads of grass and one of straw, and planks weighted with boxes filled with stones, bricks, and shingle—about 15 tons altogether. On Dec. 1 the silo was opened. The outer coating of the ensilage was mouldy and rotten, but beneath it was bright, cool, and moist, and gave off a strong alcoholic odour." Mr. H. Stevenson, the farm bailiff, reports as follows: "The ensilage was given to the milch cows mixed with a small portion of chaff. The quantity of milk very much increased, cream thicker, and the butter a rich colour and a fine flavour. I had two beasts feeding upon the ensilage; commenced giving them 7lb. each per day, mixed with 6lb. of cut clover hay, each per day, and increased the ensilage to 3½ stones each per day mixed with 6lb. of cut clover hay, each per day. By the end of April they were fat without cake or roots. The horses did well upon it, and also the sheep. The crops were considerably better where the ensilage was eaten upon the land by the sheep.

SILO AT HEATH FARM, LITTLE LIVERMERE, SUFFOLK.

FROM a report made by Mr. William Biddell, M.P., upon the erection and working of a silo, placed by direction of the Hon. J. St. Vincent Saumarez on his estate at Heath Farm, Little Livermere it appears that the structure is one of Lascelles' "portable concrete silos," measuring 24ft. by 18ft., and 12ft. high, made of concrete slabs, 3ft. by 2ft., and 1½in. thick, kept in position by timber uprights, 4½in. by 3in. The floor is of similar slabs, and the roof of corrugated iron; the cost, including 9*l.* for carriage, was a trifle under 50*l.* From June 25 to June 30 it was filled with green sainfoin, three-fourths being cut into chaff and the remainder unchopped; some of it being well trod in the same day as cut, the other the day after. The ensilage was covered with boards, weighted with bricks, amounting to 120lb. pressure to the square foot. Subsequently, the sides bulged, and had to be strengthened by props. On Oct. 18 the silo was opened, and some of the ensilage was offered to horses and cattle, which readily ate it; pigs did not care about it. The sides and top were decayed and mouldy to the depth of 6in. to 9in. The ensilage, originally 12ft. deep, had sunk down to 7½ft., and weighed 35lb. to the foot; 50¼ tons being the calculated weight of ensilage arising from what was estimated to weigh 21 tons if converted into hay.

The portions from the chaffed sainfoin and that from the unchopped portion were equally well preserved, emitting a sweet, and, to some extent, spirituous odour. On Dec. 18 the silo was again examined (there was still heat in it), when the face of the cut made for testing it on Oct. 18 was in a most unsatisfactory state, as mould and decay had penetrated a foot into it, rendering a considerable portion useless except for manure.

From the fact of the cut being so decayed, Mr. Biddell is of opinion that the less exposure after cutting is begun the better, hence a long silo would be preferable, though a square one is less costly, proportionate to its capacity. Where easily drained, he thinks the silo had better be half underground, the 6ft. of earth from below supporting the sides above; thus arranged, probably 9in. brickwork, with griers every 6ft., would be sufficiently strong. It would be easily filled, and less affected by changes of temperature. On the cost of this silo there should be a gross return of 6 per cent., or 3*l.* per annum, as rent, which, calculated up in its 50 tons capacity, gives 14½*d.* per ton. As to comparative cost, he thinks that the saving of siloing has been greatly over-estimated. In haying, the cost of cutting (in the eastern counties) is 4*s.*; making, 7*s.*; carting, say, half a mile, and stacking, 3*s.*; thatching and straw, 4*s.* In siloing the cutting is 4*s.*; carting and weighting, say, 4 tons, 11*s.*; rent of silo, say, 4*s.*; in all, 19*s.* per acre, nearly the same as in haymaking.

Mr. Biddell considers the value may be taken as follows, calculating upon, say, one ton of hay crop per acre: Value, if favourably hayed, 70*s.*; less 15 per cent. for depreciation by bad weather, 10*s.* 6*d.*; net value of

hay, 59*s.* 6*d.* The value if siloed, being 10 per cent. more than if *well* hayed, is 77*s.*, the difference thus working out to the result that, in siloing, a crop may be secured of more value by 25 per cent. than if hayed in average seasons.

Pursuing these calculations on a farm of, say, 300 acres, where 33 tons of hay or stover are generally made, and that is worth 3*l.* 6*s.* 8*d.* a ton to the farmer, there is an increased value amounting to him of 25 per cent. On 100*l.* it amounts to 25*l.*, that is, if his landlord will build him silos which will hold 100 tons of ensilage, which, it must be borne in mind, is not a saleable commodity like hay. This scheme, Mr. Biddell adds, looks remarkably well on paper, but should not advise any tenant farmer going too far with it, though we have most abundant evidence to justify small experiments.

MR. E. GIBSON'S SILOS, SAFFRON WALDEN, ESSEX.

A COVERED yard, in itself one of the best agricultural economies of recent adoption, is, in the instance to which we are about to refer (as an example of a still more recently advocated economy) inclosed on two adjoining sides by a cow byre; and immediately adjoining this, along one side of the square which we are describing, there are a succession of five cubic tanks, made of concrete, each of them 12ft. by 14ft., and 12ft. deep. They cost 150*l.* altogether. The concrete, some 6in. thick, provides a ceiling as well as walls and floor, and there is a manhole in the centre over each. These tanks are so many silos.

A crop of rye, just coming into ear in June, about 80 tons in all, was cut into chaff (about ¾in. stuff) in the field, bagged and brought to these tanks, there filled in as rapidly as possible, and trampled down by man and boy as the work was going on. The whole took seven days to do, and the manholes were well covered up with puddled clay, after as much as possible had been crammed into the silos.

When we visited the farm last Tuesday (Nov. 14, 1882), one of the silos had been emptied. Twenty-four cows had been having a bushel a day apiece of the ensilage, along with a couple of cartloads of white turnips, spread on the pasture where they were daily turned, and a truss of hay to every four in the covered yard where they lay at night. The cows looked well, and were doing well, yielding various quantities of milk, from fifty-two pints a day (?) just newly-calved, to little more than a gallon as they were drying off, after being nine months at the pail. The second silo—there is a doorway in the separating wall of concrete—was then being used, each being gradually emptied over its whole surface from the top downward.

The day's portion had been taken out, and was lying on the floor of silo No. 1, as we could see by the light through its manhole, which had been opened. It looked like chop of rather heated hay: it handled as straw-chaff which had been damped, and got nearly dry again, might handle: it

smelt most disagreeably of the slight fermentation it had undergone; and it tasted—well!—the cattle had just had their feed, but they were still standing before their well-cleaned troughs, and a skep of the stuff being placed before them they readily, after an experimental sniff, and greedily attacked it. The whole contents of the tank, except about 6in. of the top layer, when first opened is good fodder. That and some 2in. or 3in. round the wall was mouldy: the rest was wholesome, palatable fodder. There was no heat in the mass, though any quantity of it loosely thrown together heated readily enough.

Dr. Voelcker's analysis of the ensilage in this case shows that there is rather more than 72 per cent. of water still present in the stuff, and only 2·13 per cent. of ash; thus indicating that no great loss had taken place since the month of June, when the pits were filled. The presence of 8 per cent. (? 0·8) of lactic acid was, we presume, the most noteworthy illustration of the change of composition that had been experienced. There was 2 per cent. of albuminous compounds containing 0·3 of nitrogen, and there was 12·8 per cent. of mucilage and digestible fibre, and 9·7 per cent. of woody fibre.—*Agricultural Gazette.*

Mr. E. Gibson writes, Oct. 15, 1883:—"I opened one section of my largest silo last week in the presence of Mr. H. M. Jenkins, secretary to the R.A.S. It contained chaffed clover, and, with the exception of about 2in. on the surface and somewhat more immediately round the sides, for a short distance downwards, it proved to be perfectly preserved. I only find it necessary to use sufficient weight upon the surface of the battens which cover the ensilage to insure close contact with the fodder, as it is cut with chaff and well trodden at the time of filling. About fifty head of cattle, chiefly milch cows, are now eating the ensilage. It is, I consider, much better to cut the green food into chaff at the time of filling, as less fermentation takes place than when put in whole. I have used 15 acres of rye for ensilage this summer in addition to 35 acres of clover, sainfoin, and grass, making in all about 400 tons. Of course, the clover, &c., is much superior to the rye; we mix them together."—*Farmers' Almanac.*

MR. BATEMAN'S SILOS, BRIGHTLINGSEA, ESSEX.

At the Lodge Farm, Brightlingsea, three silos (or, rather, one silo in three divisions) were constructed last year for Mr. John Bateman, the builder being Mr. E. Clark, of Great Bentley; and on the 30th of January, 1884, at Mr. Bateman's invitation, a large number of persons assembled to witness the opening. The silo is solidly built of concrete, and separated by concrete walls into three distinct compartments. The total length is 47ft., the width 17ft., and the depth 13½ft., the length being divided by two transverse internal walls. The general structure is

very similar to that silo represented under the title of "The Kentish Silo," in a previous chapter. The cost of the silo was 160*l.*; and this might have been reduced somewhat had it been built originally without the divisions, which, we understand, Mr. Bateman intends to have removed.

The first compartment—that farthest from the entrance—was filled on June 18 with red clover, partly in chaff, partly unchopped, the latter forming the upper layer. The clover was very wet when pitted, and it was weighted by means of a stack of hay, built on the top of two or three layers of bricks, placed in the usual manner on transverse boards, the pressure being estimated about 100lb. per square foot. The clover, although cut when the intermixed grass was rather woody, was a very fair sample of ensilage.

The second division, or silo was filled with coarse, marsh grass, which was pitted partly very wet and partly dry. This was salted, but the addition is regarded by Mr. Bateman as quite unnecessary, and consequently useless. The silo was filled on July 6, and the contents were pressed with 130lb. per square foot. The resulting ensilage was a most admirable sample—very sweet and fragrant.

The third division was filled with chopped maize, which was cut and pitted on Sept. 6. A biting gale on Sept. 1 had stopped the growth and withered the tops, and when about 70lb. pressure was put on the chopped maize, floods of juice exuded from the silo; and when the silo was opened the ensilage had passed into the acetous stage, evidently from insufficient expulsion of the air. This maize ensilage was not used for the horned cattle, but kept exclusively for the breeding ewes on the farm.

The stock generally have been for some time fed on ensilage from other silos, which they eat greedily, and it is found that the cows so fed yield a larger quantity and better quality of milk. The butter from the farm was on view and was rapidly bought up by the visitors at 1*s.* 7*d.* per pound; it was excellent both in colour and flavour.

Mr. Bateman is so satisfied with the result on the Lodge Farm that he intends building larger silos on two other farms. The experience gained during the past season will lead to improvements in the future arrangements; it is proposed to substitute for the heavy sliding iron roofs, which are now used, lighter and consequently less expensive constructions covered with Willesden paper; and in place of the concrete barrels now employed to produce the requisite pressure, it is contemplated to utilise Potter's hydraulic jacks and channel standards built into the inner walls of the silos.

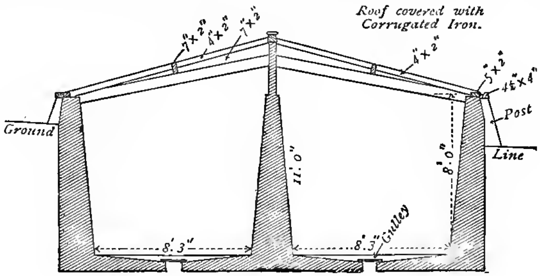
The attendance, despite the exceedingly unfavourable weather, was large, and the general impression produced was one strongly in favour of the system. The coarse grasses which are produced by the low-lying, salt marshy land of the district, were admirably preserved, and afforded a good sample of the value of the process of ensilage.

ENSILAGE AT THE ST. ALBAN'S DAIRY FARM.

(From the *Live Stock Journal.*)

In the year 1882 I erected two pits for storing grains, and filled them last year with 100 tons of grains, which came out first rate; this year, wishing to be in the fashion, I re-named the said grain pits, and they are now called silos.

The two silos are made of bricks, cemented inside, and roofed with galvanised iron, and they cost a few shillings under 50*l.* I inclose a



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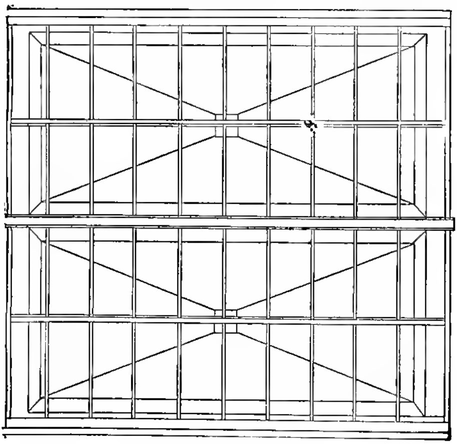


GROUND PLAN.

plan and section, which will give the size, &c. They drain into a small cesspit outside. One silo would therefore cost 25*l.*, and this amount, to be repaid within twenty-five years by equal annual payments of principal and interest at 5 per cent., would incur an annual payment of 1*l.* 15*s.* 3*d.*

Three years ago I laid down 30 acres of arable land with grass seeds. The crop this year was very poor, not more than one load to the acre, and almost entirely bents, there being very little undergrass. I decided to fill one of the silos with this grass, and accordingly commenced cutting on the 14th June with two mowing machines, and on the 15th the grass was carted and cut into chaff by a steam engine. The work was commenced at 9.30 a.m., but in consequence of a severe storm, the machine was stopped at 11.30 a.m., the silo being not quite half full; the 16th was wet all day, and therefore the machine was not started; the 17th was Sunday; and on the Monday, the 18th, the machine commenced at 9.30 a.m., and the silo was completely filled by 2 p.m.

Twenty-three men were engaged, both on the 15th and 18th, as follows:—4 men treading silo; 7 filling sacks and carrying to pit (about 10 yards); 1 unloading the cart; 2 feeding chaff machine; 1 engine driver; 1 waterman; 7 loading carts and dragging. The men were engaged for three hours on the 15th and four and a half hours on the 18th at 3*d.* per hour. Three horses and carts were employed.

It took 6½ acres of the grass to fill the silo, and the grass weighed 15 tons 5 cwt., 2lb. of salt being added to each cwt. of grass.

Cost of Filling and Weighting the Silo.

	£	s.	d.
June 14, 1883.			
Mowing 6½ acres of grass with machine, including beer for men, but exclusive of horses, 1*s.* 8*d.* per acre	0	10	10
Raking three rows into one, putting into small cocks for carting, and breaking salt, including beer for men, 2*s.* 5*d.* per acre	0	15	8½
June 15.			
Twenty-three men, three hours each at 3*d.* per hour, carting, cutting chaff, and pitting, including beer (but exclusive of horses)	1	0	2
June 18.			
Twenty-three men, 4½ hours, at 3*d.* per hour, ditto	1	10	8
Paid for steam engine and chaff-cutter, 7½ hours, at 3*s.* per hour	1	2	6
Five cwt. of coal	0	4	4½
Five and a half cwt. of salt	0	6	0
	£5	10	3

Average per acre, 17*s.*

The top of the grass in the silo was covered with thick wooden doors, on the top of which was placed 1 ton 3 cwt. of old iron gas pipes, and twenty American flour tubs filled with the same description of chaff as in the silo, each tub weighing 85lb. The doors weigh about 2cwt., thus making a total weight of 2 tons.

My object in using the flour tubs was to ascertain if the grass would keep good in them; because, if so, the weights to be placed on the silo will not only be easily obtained, but at the same time will be serviceable

and cheap. Following is an account of the cost of the covering and weights on the top of the grass in silo, viz.:

	£	s.	d.
Doors	0	15	0
Twenty tubs, at 1*s.* 4*d.*	1	6	8
One ton 3cwt. of iron........	2	6	0
	£4	7	8

The above to be repaid within five years by equal annual payments of principal and interest at 5 per cent. would incur an annual payment of 1*l.*

Heat and Sinking of Grass in Silo.

I placed a thermometer on the top of the boards under the iron roof, and examined it daily, and at the same time ascertained the sinking of the grass.

June	Therm.	Sinking.
19	64°	None.
20	60	A little in centre.
21	62	3 inches in centre.
22	72	Do. do.
23	72	1 inch in centre.
24	74	1in. in centre and 1in. outsides.
25	74°	1 inch in centre.
26	72	Do. do.
27	68	None.
28	69	None.
29	70	1in. in centre and 1in. outsides.
30	69	None.

Total, 11in. in centre, and 2in. on the outsides.

Cost of Haymaking.

The remainder of the grass was made into hay, namely, 23½ acres.

June 14, 15, and 16, 1883.	£	s.	d.
Mowing 23½ acres with machine, including beer for men (but exclusive of horses); all men were paid 3*d.* per hour while at work........	1	19	2
19. Eleven men haymaking, including beer	0	15	8½
20. Nine men ,, ,, ...	0	4	9
22. Sixteen men haymaking and carting, including beer (but exclusive of horses)	0	17	9
Fifty faggots for bottom of rick	0	7	6
Six truss of straw for rick bottom	0	5	0
23. Twenty men haymaking and carting, including beer	2	18	8
25. Nineteen men ,, ,, ,, ...	1	9	7½
26. Four men haymaking	0	5	4
27. One ,, ,, ...	0	3	0
28. One ,, ,, ...	0	1	4½
29. Nine ,, ,, and carting........	1	3	7
30. Men pulling rick and making good for rough thatching ...	0	7	6
Paid for rough thatching and beer	0	5	0
1½ load straw	2	14	0
Thatching for good	1	0	0
Wear and tear of rick cloths and elevator	1	0	0
Insurance of hayrick	0	5	0
	16	2	11½
Estimated cost of cutting 23½ loads of hay into chaff by steam, including men, beer and coal	9	12	6
Eleven cwt. of salt	0	12	0
	26	7	5½

COST PER ACRE—SILO VERSUS HAYMAKING.

SILO.	£	s.	d.	HAYMAKING.	£	s.	d.
Cost of filling silo as per account per acre	0	17	0	Haymaking as per account per acre	0	13	9
Moiety of cost of building two silos, including interest at 5 per cent., principal and interest to be repaid in 25 years (per acre)	0	5	5	Estimated cost of cutting the said hay into chaff, and storing as per account per acre	0	8	$8\frac{1}{4}$
Cost of covering and weights on the top of grass, including interest at 5 per cent., principal and interest to be repaid in 5 years (per acre)...	0	3	1				
Total per acre...........	1	5	6	Total per acre...........	1	2	$5\frac{1}{4}$

I have not included any charge in the above for horses, as they are kept on the farm all the year round, but if charged the amount would have been as follows:

	Silo per acre. s.	d.	Haymaking per acre. s.	d.
Horses charged at 6*d.* per hour while at work mowing, per acre..	1	8	1	8
Carting, dragging, and using elevator for hay, per acre ...	1	4	2	10
	3	0	4	6

THE WEATHER DURING THE PERIOD.

June 14 Fine all day.
„ 15 Dull; began to rain at 10.30. A storm at 11.30.
„ 16 Showers all day.
„ 17 Slight showers at intervals.
„ 18 Dull, but no rain.
„ 19 Ditto.
„ 20 Fine up till 11 a.m.; then showers all day.
„ 21 Showers all day.
„ 22 Fine up to 3 p.m., and then rain for rest of day.
June 23 Fine all day.
„ 24 Rain at 8 a.m. and 11 p.m.
„ 25 Dull morning. Rain from 3 p.m. to 6 p.m.
„ 26 Showers all day.
„ 27 Dull morning. Showers from 1 p.m.
„ 28 Showers all the morning.
„ 29 Fine all day, but a severe thunderstorm at night.

From the above it will be seen that I was blessed with the usual wet weather, namely, out of sixteen days eleven were wet.

Although the cost per acre is a little more for the silo than for haymaking, the silo being independent of the weather will more than counterbalance the difference, provided the grass in the silo turns out well.

ISAAC N. EDWARDS.

Westminster Lodge, St. Alban's, July 13, 1883.

SIR,—In accordance with my promise of July 13 last, I have the pleasure of informing you that I opened my silo yesterday (Dec. 4) in the presence of Sir J. B. Lawes, Dr. Gilbert, Dr. Voelcker, Messrs. Walter Gilbey, John Thornton, H. M. Jenkins, Jas. Macdonald, Thomas Nuttall, C. Woollam,

G. M. Marten, C. C. Hayward, and others. On removing the corrugated iron roofing, we found that the wet had been entirely kept out, and on taking away the boarding, we discovered that the surface of the ensilage for a depth of six inches was rotten, that the next twelve inches were mouldy, and that the ensilage from that depth was good, and gave off a pleasant aroma. The grass having consisted entirely of bents, it was not so moist as is usual for ensilage, and I think the bents when cut must have been a little too ripe to insure perfect ensilage. However, I look upon the experiment as a success, and I hope from the lesson I have learnt to benefit by it next season. A portion of the rotten and mouldy ensilage, and a portion of the good, were given to the cows, and they ate with a relish which astonished all present.

Having now obtained the ensilage, I intend to test its milking qualities, and also its nutritive value as compared with roots. Sir J. B. Lawes has very kindly consented to take charge of this experiment, and under his able guidance I have no doubt we shall be able to ascertain the true value of the ensilage. When the experiment is concluded I will give you the result.

ISAAC N. EDWARDS.

Westminster Lodge, St. Alban's, December 5, 1883.

[We have not yet (April) seen any report of the feeding experiments.]

MR. WHITBREAD'S SILO, CARDINGTON, BEDFORD.

LAST summer a silo was built by Mr. Whitbread on his farm at Hillfoot, parish of Cardington. It is a substantial brick building, entirely above ground, and divided by brick partitions into four rooms, each measuring 18ft. deep, 18ft. long and 9ft. wide, cemented on the inside walls and floors. Two of them were filled last season. The one which had been opened was filled with the produce of about 2 acres of tares and 8 acres of red clover passed through the chaff-cutter. The other was filled with green oats cut up in the same way. These materials were trodden hard in the process of filling, and on the top thick boards were laid, weighted with 12 tons of granite, being a little more than 1½cwt. to the square foot. Only the clover has yet been tested, and it proves equal to the highest expectations formed of it, and is being daily served up to the bullocks and calves—a half bushel to a bushel per day, according to the size of the animal. They are also fed with barley straw and chaff, with a little flour and cake. The stock also get barley straw once a day, and take about the same quantity of water as when fed with chaff and pulped turnips. From 1½in. to 2in. were found moulded on the top of the silo below the boards, and a trace of the same at the corners of the wall. Some moisture appears to have escaped at the bottom of the wall from the silo in which the green oats were stored, but very little from the clover.—*Bedfordshire Times.*

MR. MOUFLET'S WOODEN SILO, SOUTHALL.

SIR,—In June last I had a silo built of wood, the construction of which, and the result of the ensilage, may prove of interest to some of your readers.

The silo is erected on a platform of concrete upon the surface of the ground. The sides and ends are constructed with 4in. fir quarters, properly framed, and having struts and braces; the sides are tied in by the roof principals. The sides and ends are further stiffened, and tied by angle-ties. The quartering on the outside is covered with weather boarding coated with tar, and on the inside it is lined with 1in. boarding laid vertically. A doorway is formed at one end to open outwards. The interspace between the quarters and the inside and outside boarding is filled in with puddled clay, also at the doorway (the silo being filled at the top before the roof was completed). Around the sides of the silo, externally, a luting or skirting of clay is put. The roof is covered with corrugated iron, segmental in form, supported on two principals. The rain is conveyed from the roof by eaves, guttering, and rain pipes. The end of the silo having the door was strutted externally by temporary struts, which was the only strutting that was necessary. The ensilage was weighted by 1½in. deal boarding covered with five courses of bricks laid over same. The size of the silo is 24ft. long, 12ft. wide, and 10ft. high, all in the clear. The cost complete was 53*l.*, exclusive of the bricks for weighting. The framing of the silo was constructed in the above manner as an experiment, and bolted together so as to be easy of removal.

We began filling on Sept. 7 with clover (second cut), mown and carried the same day in a very wet state. We put in about four tons daily, well treading the same, especially at the sides; but, not having sufficient clover to fill the silo, we made it up with meadow grass (second cut), and estimate the amount of clover at sixty tons, and grass fifteen tons. On the top we placed five trusses of straw, then the boards across the silo, and weighted with 4650 patent bricks, weighing 7lb. each, or fifteen tons in all, equal to about 100lb. to the square foot. The corrugated iron roof was then put on, the whole being completed on Oct. 4.

When the silo was half filled, the temperature 6in. from the surface was 120°, and 3ft. down 90° Nearly the same heat was observed on the top.

The silo was opened on Jan. 1, and found to have sunk 4ft., leaving 6ft. of ensilage tightly compressed. With the exception of the straw on the top and against the door, there was no appearance of any mould whatever. I have sent you a sample of both the clover and grass ensilage for your inspection. The cows did not appear to relish the clover, so we chaffed it with hay and straw, and they seem to like it better each day; the grass ensilage they took to more readily.

If any of your readers like to inspect the silo, I shall be glad to see them at the farm. The nearest station is Southall on the Great Western Railway. F. C. M.

Waxlow Manor Farm, Southall, Middlesex, Jan. 16, 1884.

[The grass ensilage was first-rate—one of the very best samples we have seen. The clover, which was sodden with wet and very dark-coloured, was not so good. Apparently it had been left till it was rather old before it was cut.—Ed.]

CROYDON SEWAGE FARM.

The experimental silos on Croydon Sewage Farm are two. One of these was built by the Farm Committee, and the other by Messrs. Lascelles, of Bunhill-row, Finsbury. The former is of concrete, erected against the brick wall of a shed. Its dimensions are 15ft. by 8ft., and 10ft. in depth, a lean-to roof being placed from under the eaves of the shed. The cost of this was about 12*l.* The silo sunk is about 3ft. in the ground; but, as it has a concrete bottom, it is quite dry.

The other silo is 16ft. long, 12ft. wide, and 12ft. in height, the whole standing on the surface. This is constructed of Lascelles' concrete slabs, fixed and made watertight by means of uprights and caulking with coarse hempen tow, or other similiar compressible fibre. This silo is portable, and its parts are readily fixed by farm labourers. Its cost was about 25*l.*

But it is the quality of the ensilage in the two silos that is of special interest. The silos were filled with green grass, sewage grown in June and July. In the home-made silo the grass was chopped iuto lengths of about two inches. The covering and weightiug consisted of old railway sleepers and about four tons of bricks, and other heavy material at hand. The weight of the ensilage in this pit was about 40lb. to the cubic foot.

Lascelles' silo was filled with long grass, just as it came from the scythe. This was weighted with a layer of railway sleepers only. The ensilage in both silos was a little fusty on the top, the lightly weighted being a little more so than the heavier weighted.

These silos were opened on Dec. 26, and when I saw them after a week there was not the slightest sign of mould on the surface where the ensilage had been cut from, nor was there any apparent change in the loose heap that lay at the bottom of the square which had been cut out.

From these points of observation I conclude that ensilaged sewage grass is a satisfactory success. On the strength of this, too, I was pleased to hear that some influential members of the farm committee intend to propose that silos of Lascelles' pattern, to hold ten or twelve times the capacity of the one above-mentioned, shall be erected in the coming spring. W. W. G.

MR. BRASSEY'S SILO AT AYLESFORD, KENT.

On the invitation of Mr. H. A. Brassey, M.P., on Dec. 17, 1883, a number of agriculturists assembled at Preston Hall Farm, to witness the opening of a silo. For the purpose one of the farm buildings had been utilised, and the green stuff stored in it had been cut in fine weather, although it was carried while covered with dew. On June 12, twenty tons of grass was cut and carried straight into the silo, 2in. planks were put on the top of it, and these were weighted down with concrete blocks, the pressure being about 28lb. to the square foot. The silo was opened on June 23, and it was found that the contents had sunk 5ft., the depth having before been 10ft.; the top portion was mouldy, but wheu that was removed, the food was brown and sweet. Fourteen tons of grass were placed on it, and it was then covered up and weighted as before. On Aug. 24, the silo was opened again, and the ensilage had sunk slightly over 4ft., the top part being mouldy, and the building emitting a strong sour smell. The mouldy portion was removed, and the silo was refilled with about 12 tons of rye grass. It was then covered over and weighted as before, and the building, which was 20ft. by 13ft. by 10ft., in dimensions, was bricked up. On Monday, Dec. 17, it was again opened, and the results were viewed with a great amount of interest. A large cut was made right into the ensilage, which was found to be of a dark brown colour, with somewhat of a greenish tint, and the odour was far from pleasant. Eight inches from the surface was mouldy and of no good; but as for the rest the general opinion was that the experiment had been tolerably successful, although more weight might have been applied with advantageous results. The silo is said to contain about 30 tons of good feeding stuff.—*The Farmer.*

MR. KIRBY'S SILO AT BROMLEY, KENT.

At the Dairy Show at Islington, in October, 1883, a small wooden model of two silos was exhibited by Mr. Thomas Kirby, of Hook Farm, Bromley, Kent, who also exhibited a very solid small truss of unchopped grass ensilage, computed to weigh 49lb. per cubic foot. Of his experiment Mr. Kirby wrote as follows: "Having a herd of 130 cows to supply with forage, I thought I would try ensilage. I built my pits (two in number) during the latter end of April; they were composed of 14in. brickwork, well cemented inside, and built 6ft. in the ground and 6ft. out. They were 24ft. long, 8ft. wide, and 12ft. deep. During the first week in May I cut my grass, a piece of three-year-old permanent pasture, which I reckoned was about 9 tons of grass per acre. I put the grass into the pits directly after it was mown, and did not cut it into chaff; but it was well trod in the pits by about a dozen men, and

afterwards by a horse. When the pit was nearly filled, the grass was covered with 3in. deals, and weighted with bags of sand and gravel; in two days it sank to within 4ft. from the bottom of the pit, when the sand and deals were taken off, and each pit filled up again. They were filled and pressed in this way three times. The third and last time of filling, the grass was covered with a 3in. layer of straw, when the deals were placed on and covered with a 3in. layer of earth. It was then pressed down with the bags of sand and gravel and lot of stones, making about twenty tons weight on each pit. When the pits had been pressed in this way about a fortnight, we put all the stones on one pit for a fortnight, and then shifted them all back again, so that each pit in turn had all the weight on it. The pits were opened on Sept. 3. When opened, I found the ensilage round the doorway and sides slightly mildewed, and darker in colour than the bulk, and I also noticed an unpleasant smell, which was very pungent: but for all that, the cows and cart-horses ate it greedily when given to them. The part which was mildewed I had taken ont to some cows in a field, where it was well shaken about, and in twenty minutes they had picked it over and eaten nearly all of it. I started feeding my cows upon it at once, and have done so ever since. I find they give as much milk, and of better quality, than they do on the best artificial food, and also that the butter made from the milk contains that nice flavour and colour which has only been obtainable when cows have been turned out in fresh green grass."

MR. HOARE'S SILO, STAPLEHURST, KENT.

MESSRS. CARTER and Co., of High Holborn, wrote to the *Agricultural Gazette* of Jan. 29, 1883, as follows: "A few days since we visited Mr. Hoare's silo at Pagehurst Farm, Staplehurst, and had some interesting conversation with Mr. Austen, the bailiff, a thoroughly practical and well-informed man. The capacity of the silo may be described as two 10ft. cubes, separated by a wall of the same material as the surrounding walls, the contents being about 50 tons of trifolium, the produce of three acres. The crop was carted straight to the chaff-cutter, and, being chaffed, was trodden well down in the silo, no interval being allowed. There is a drain from the silo, but Mr. Austen has never seen anything come from it, nor has he observed any sign of heating. The ensilage is cut out with a hay knife, and cuts like a good solid hayrick. It comes out nice and moist, and no cattle have yet refused it, although, if fed upon it exclusively for a considerable time, they are apt to tire of it, so that it is mixed with chaffed hay, and makes very good feed. Mr. Austen thinks there is certainly more fodder in the ensilage than in the same crop made into hay. If such a succulent plant as Trifolium incarnatum can be made into good ensilage, there seems but little reason for doubting that any of our forage crops may be as successfully treated."

EARTHEN SILOS.

Mr. Solomon's, at Ifield, Kent.

Sir,—Having made up my mind to try the making of ensilage, I send you the result of my experience. My plan was a very primitive one, for I did not feel disposed to go to any great expense about the matter. I simply dug a hole in the ground and buried my haystack. I selected a spot of ground where I would get the greatest depth of soil most easily moved, and dug a hole 21ft. long by 12ft. wide, and, by the aid of some 9in. by 3in. deals laid on edge round the hole, the soil thrown out thus helped to increase the depth of the silo, which I made altogether 9ft. 6in. deep.

On June 1, I commenced cutting trifolium, and carted it, as it was cut, direct to the silo, threw it in and trod it down. When nearly full I induced a horse to walk in and tread it down, and found that helped considerably to increase the quantity we got in. When full, we ceased for the day. Next morning it had sunk about a foot. I had it filled again, and repeated the operation on the third day; but it did not take much more that time. Then we proceeded to cover it up. I laid some 2in. battens on the trifolium with intervals of about 6in. between them (because I had not enough to go closer) and shovelled on the earth regularly all over to the depth of about 2ft. This quickly caused the contents to sink till we could remove the whole of the deals forming the temporary top of the silo. At intervals of a few days I increased the earth on the top to about 3ft. thick all over, and then left it without any further protection.

On Monday, Dec. 24, I opened one end, and removed two battens, so that we could cut down a piece about a truss wide. The top, for about two inches, was slightly mouldy and black, and the outside, next the earth was the same for about six inches; but the inside I should consider excellent. It is of a bright green colour—almost, one might say, yellowish-green—and the red blossom almost as bright as when put in. There was not the slightest heat, or appearance of having been any, and the smell—well, there are about as many different descriptions of that as there are people who smell it, some complimentary, some the reverse.

But the main point is, will stock eat it and thrive on it? I found that, on giving it to both bullocks and horses, they looked very shy at it at first, and did not care much about it; but by the third day the bullocks and cows ate it greedily. The pigs were not so nice, but ate it from the first as readily as if it had been fresh-cut green-meat.

I do not find that there would be much difference in cost between putting into silo and making into hay, as the cost of turning and making into hay would be counterbalanced by the extra weight of green stuff (five times) to be carted to the silo. Mine was quite dry when cut, as the weather was then very fine. It does not appear at all necessary to chaff it before pitting.

I put the produce of $4\frac{1}{4}$ acres into my silo, and calculated it at 27 tons. The thickness now averages about 4ft. 6in., which would show about 42 cubic feet per ton, and that the contents were compressed to rather less than half the original thickness.

I consider the result of my trial very satisfactory, as the outlay was small and the ensilage good. It cost me about 30*s.* to dig the silo, and my battens, which are not much the worse for my temporary burial, say, depreciated one-third in value, 10*s.* more. This would represent all the expense in my case over making into hay. In the one case, however, you are pretty sure of getting a uniformly good article, but in the other you may get a good haystack, or you may not; and my own experience of trifolium for hay is that you get three very indifferent stacks to one good one, and therefore, if only for that reason, this is one of the best crops that can be grown for ensilage.

My statement of cost shows 1*s.* 6*d.* per ton as the outlay, but this amount would be even less another year, as I should only slightly enlarge the old silo; and the fact that I think of so doing will prove to you that I feel satisfied with the result of my little experiment.

Ifield, Gravesend, Dec. 29, 1883. JOSEPH SOLOMON.

P.S.—Since writing the above, I have come to the bottom of the first cut in the silo, and I do not find that there is the slightest injury caused by its being in contact with the earth at the bottom; and the dàmage at the sides, which I spoke of as being about six inches, we found was less and less as we got nearer the bottom. Then, again, the damaged (?) outside was pared off as we cut the ensilage out, and, being considered comparatively worthless, was thrown into the cattle yard as waste, but the beasts (some large steers) immediately ate it all up clean; so that there really is no waste at all. The colour changes with exposure to the iair; t gets darker and duller quickly.

MR. HARGREAVES'S, BACUP.

SIR,—I send you by parcel post a sample of ensilage, and shall be glad if you will give a report of it. I may say that the silo is 12ft. by 6ft., and 9ft. deep, dug out in the ground, and weighted with pig iron, nine tons being placed upon it. We put it in about the first week in August, cut it with the mowing machine, and trod it well in and allowed it to settle three times, and the last time we thought it could not possibly get lower. However, we find it has settled 24in.

The silo, I consider, is a success. Our cattle will pick it out of the hay, and I hope soon to know the effect it has on the milking capabilities of the cows. J. HARGREAVES.

Greenock House, Bacup, Jan. 21, 1884.

[For so simple a silo, we consider this to be a remarkably good sample—attributable, in all probability, to the ample weight, which amounts to $2\frac{1}{2}$cwt. per square foot.—ED.]

DR. FOULIS'S, CUPAR, FIFE.

Dr. Foulis, of Cairnie Lodge, had last year a very luxuriant crop of aftermath—*i.e.*, second cutting of clover and rye grass hay—and, stock having been dear and ill to get, he resolved to convert it into ensilage. But he did not build a silo; he dug into the soil in a slope to a depth of 7ft. at one end. The excavations were used to make up the other end until he had a pit all below the surface of 7ft. in depth, 9ft. in width, and 14ft. long. In the made-up part the soil was lined with battens. No building or cement was used, so that the cost of the silo was almost nil beyond the labour. A drain was run along the floor about 18in. deep, and at each side there was a 3ft. drain to keep out surface water.

The forage used was entirely aftermath clover, except one load of tares, which was put into a corner. The first layer was put in in September. Eight tons, in spite of hard trampling, filled up 5ft. A week's pressure reduced this to 3ft. Then seven tons were deposited, and filled the silo level with the surface. Another week's weighting reduced the mass to 5ft. Then six tons were laid in, and this raised the heap 2ft. above the level. It sank these 2ft., however, in the course of a week, and, two more tons having been added, the silo was finally closed early in October. Railway sleepers were placed over the fodder to the weight of a ton, and these were uniformly covered with two tons of pig iron. Guano bags were laid over the iron, and topped by about 15in. of soil.

The grass was not chopped; no salt was used. The first consignment was dry when deposited, the second very wet, and the third damp. The silo was protected from the weather by means of sheep-flakes covered with guano bags, taking something of a tent-like shape. The silo was opened on Jan. 2, when it was found that the mass, which when put in amounted in all to 14ft., had subsided to 5ft. The covering, excepting the roof canvas, was wholly removed at once, and the mass cut into at one end in the usual way. The ensilage was found to be in good order. Dairy cows ate it readily, and have been fed on it since Jan. 2, each cow getting about a cubic foot, or 48lb., daily. The flow of milk from the cows fed on ensilage increased about 15 per cent., and the quality of the butter was first-class.

On Jan. 22 about a hundred landlords and farmers, on the invitation of Dr. Foulis, assembled at Cairnie Lodge to inspect the silo and its contents, and taste the milk and butter from the ensilage-fed cows. The company were favourably impressed with the success of Dr. Foulis's experiments, especially with the great economy practised in the construction of the silo. It was observed that the clover deposited in a dry state made the best ensilage. What was put in very wet did not yield so satisfactorily to treatment. The mass sunk more in the middle than at the sides. For a few inches down at the sides, where the pressure had not been sufficient, the ensilage was not good, but the rest of it was excellent, sweet in flavour, and evidently palatable to stock.

LASCELLES' PORTABLE CONCRETE SILOS.

MR. EARLE'S, HAYTON, LIVERPOOL.

SIR,—I opened one of Lascelles' portable silos to-day, and have sent yon a sample by rail, about which I shall be glad to have your opinion. The silo measures 15ft. by 12ft. by 10ft. It stands in a large barn, on a stone floor. There is no drain, nor have I noticed the necessity for any. We commenced filling Sept. 11 with second crop green clover, passed through a large hay cutter driven by steam, and the silo was finally closed Sept. 18, being covered with planks 5in. wide by 2in. thick; over the whole was evenly distributed $9\frac{3}{4}$ tons of iron ballast. The clover when put in weighed 29 tons, and has sunk 2ft. 6in. No straw, bran, or chaff, or salt was used.

About four inches on the top was discoloured and mouldy, and about two inches at the sides. A good many farmers from this district were present, and expressed themselves much satisfied with the result.

FREDERIC W. EARLE.

Edenhurst, Hayton, Liverpool, Jan. 4, 1884.

[The sample sent was in excellent condition, and very pleasant in flavour.—ED.]

MR. CARDWELL'S, HORSTED KEYNES, SUSSEX.

THE silo, 15ft. by 9ft. by 3ft., was put up in one of the bays of a wooden barn, upon a concrete floor, and was filled in June with a crop of unchaffed green oats up to within two feet of the top. It was then filled up to the top with rough grass. The operation of filling was extended over a week, not more than two feet being put in at a time, no weights being put on until the silo was full. The fodder was weighted with 3000 bricks, the weight per square foot being a little over 140lb. The fodder was covered with a layer of bran, and over the bran we placed some rough canvas to keep out any brick dust, but no planks were used. The total sinkage when the silo was opened was exactly four feet, or half the depth of the silo.

In opening the silo we removed the bricks for a space of about three feet square in one corner, and cut straight down with an ordinary hay cutter. Having got out the first cutting, we then unscrewed a row of slabs and fixed on the door. I estimate the amount of ensilage at 11 tons, but if the weights had been taken off and the silo refilled, we should have had nearly double the quantity, and I think 20 tons would be a fair estimate of its capacity.

The silo shows no signs of being affected by the lateral pressure, but I must remind you that the sill plates and head plates are 9in. by 3in. instead of $4\frac{1}{2}$in. by 3in., although on the other hand we have no tie rod

across the centre. I think the tie rod would be found inconvenient in practice, while the extra width of the head plates is very convenient for the men to stand on, and for resting the weights upon when not in use.

The sides of the silo appear to be quite watertight, but a certain amount of liquid oozed out between the sill board and the concrete floor. This, however, does not appear to have effected the quality of the ensilage, which is in good condition. Some of the cattle were rather doubtful about eating it at first, but now they are all very fond of it, and the cows prefer it to hay. ARTHUR M. CARDWELL.

Valley Home, Horsted Keynes, Sussex, Oct. 19, 1883.

[A sample of this ensilage sent to us was in excellent condition.—ED.]

MR. LASCELLES', GLOUCESTER ROAD, CROYDON.

The cost of this silo (15ft. long, 12ft. wide, and 10ft. high) is 16*l.* in London, the carriage was 2*l.*, and fixing 2*l.*—or 20*l.* in all. To this would have to be added the cost of the covering boards, which might be 3*d.* or 4*d.* per square foot, according to the thickness of the boards used: or, if concrete slabs were adopted instead, they also would cost 4*d.* per square foot; and this, on 180ft. of surface, would amount to 3*l.* The cost of the roof and weights would also vary with the material nsed. In this case the ensilage was weighted with lumps of concrete, stone, tiles, iron, and any available lumber; and the pressure was estimated at about $1\frac{1}{4}$cwt. per square foot.

The quantity of grass put into the silo consisted of twenty-three two-horse loads, which were estimated to weigh 50 tons—an estimate, however, which looks rather excessive. It was rye grass, produced on $4\frac{3}{4}$ acres of the sewage farm belonging to the Croydon Corporation, and was purchased by Mr. Lascelles for this experiment, and carted to an inclosure of his in Gloucester-road, Croydon. A previous experiment with a Lascelles silo on a smaller scale had been made on the sewage farm, but the result was not altogether satisfactory, for a partition was pnt in the silo to separate two crops, and the boards and weights were laid over this, so that they could not sink properly when the grass settled down, and the ensilage was damaged accordingly. In the present instance, the ensilage, we understand, is sold to a dairyman in the neighbourhood, whose cows we saw eating some of it with evident relish. The total weight of the contents of the silo, when opened, was estimated at about 30 tons, so that, if the two estimates be correct, there would be a loss of about 20 tons. No doubt a considerable reduction in weight has arisen from moisture draining away into the soil or into a shallow trench cut around the silo; for it stood upon the bare soil, and Mr. Lascelles says he preferred not to make the bottom water-tight, thinking the great amount of moisture might possibly spoil the ensilage if the whole were kept in. The drainage, however, must have been very considerable to

account for the difference between the estimates. The cubic contents of the silo are 1800ft., and 50 tons in this space would amount to $62\frac{1}{2}$lb. per cubic foot; hence the estimated weight of the grass put in was as much as if the silo were filled with water up to the very brim; and grass sodden as it may be, never can weigh so much as this. Possibly, however, some of the loss may be accounted for by water draining away during the process of carting and filling. The filling extended over a fortnight or three weeks (no weights being put on in the interval), so the grass would settle down considerably in the interval, and there would be ample time for some of the water to leak out.

When the silo was opened, on March 15, the ensilage at the surface weighed about 40lb. to the cubic foot; two or three feet lower down it weighed about 50lb., and at the bottom it will doubtless weigh some pounds heavier. Probably owing to the draining off of the moisture, the grass at the upper part had shrunk away from the sides, so that one's hand might be thrust down between the ensilage and the concrete slabs, showing that there evidently could be no lateral pressure there. But, although there was this vacant space, there was very little indication of mouldiness. Some ensilage had been cut out at one end, several days before, and we were told that, after the cutting, the part exposed to the atmosphere heated so much that it "smoked," and mouldiness to the depth of about an inch was found in the course of a couple of days. There was also some acidity in the upper part of the silo. The ensilage that we saw cut out two or three feet from the top seemed well preserved. Of course, from the character of the material, it could not be expected to compare in quality with that made from good meadow grass; but the result was very satisfactory, considering the unfavourable nature of the herbage from which the ensilage was made.

One arrangement might have been improved upon. The sile was opened from above, and visitors ascended to a wooden stage, and looked over into the interior; while the ensilage cut out had to be lifted over the top on to the stage before being carried down. It would have been much more advantageous if provision had been made for unscrewing a few slabs at the end of the silo, so as to form a kind of door for cutting out the ensilage. A sectional view of the contents would have been far preferable to a surface view; there would have been less uncovering and removal of weights, and less deterioration would be likely to result from the smaller amount of surface exposed; while the labour of taking out the ensilage would be reduced.

Mr. Fraser's, Arngomery, Stirlingshire.

Sir,—I have made a very successful experiment this year with one of Lascelles' Concrete Slab Silos. On the 4th of July last I put 20 tons of ordinary pasture grass into this silo, loading it with about 20 tons of stones; and on opening it on Nov. 13, in presence of a number of farmers, they unanimously declared the ensilage to be in capital condition, with

only an infinitesimal amount of waste on the top and sides, and on placing it before several cows they all ate, and seemed to relish it. My loading was unusually heavy, to which I attribute the small amount of waste.

With regard to the chopping or non-chopping of long grass, or any other article which is to be put into a silo, I feel satisfied that the labour or power necessary for the chopping will be more than repaid by the extra amount which can be put into the silo, the great saving of labour in tramping, and the decreased loading which would be necessary for its compression.

I herewith send you sample of my ensilage as made in one of Lascelles' silos from pasture grass of poor quality, and shall be glad to have your report thereon. I feel satisfied that the question of waste is very much one of weighting, as where I have applied a pressure of something like 500lb. to the square foot I have no waste at either top, bottom, or sides. R. H. F.

[This sample, which is of very fine grass, is in excellent condition. —Ed.].

MR. PHILPOTT'S, COSHAM, HANTS.

SIR,—I send you my experience with one of Lascelles' portable silos, The dimensions are 12ft. by 9ft., and height 10ft.; the cost of 23*l.* 7*s.*, including railway freight and putting together.

From information about American silos, gleaned from the *Field* last year, I decided to fill my silo in layers of 6in. to 12in. thick, putting in successive layers at intervals of one or two days. I began with rye—become too tough for cows to eat—and put in four layers between June 14 and 19, not chaffed. Between June 21 and 25, I put in four layers of clover and rye-grass; and, between June 26 and Aug. 2, I put in twenty layers of meadow grass. On Aug. 3 I weighted it with boxes of stones, giving about 70lb. to the square foot. The ensilage sank down 2ft. the first day, and 2ft. more subsequently. When I began using the ensilage on Nov. 6, I found it in good order, with the exception of 4in. on the top and about 1ft. at the sides and ends, and the rye at the bottom.

The failure at the sides was due, no doubt, to my not using weights to press it down at the sides during the process of filling. The grass in the middle of the silo always sank down more than at the sides, and this tendency was exaggerated by the use of so many layers. To counteract this tendency, I intend to use old iron rails or pig iron to weight the sides down equally with the middle, Another failure was the rye. This, being old and unchaffed, retained so much air as to spoil the layer of clover and rye-grass next to it. My chief object in contributing my experience is to emphasise the necessity for pressure at the sides.

Closewood, Cosham, Hants, Jan. 15, 1884. O. P.

[Other experiments with Lascelles' silos are described on page 272 (silo at Heath Farm), and page 282 (the Croydon Sewage Farm).]

SILO AT GRAFTON UNDERWOOD, NORTHAMPTONSHIRE.

A silo, constructed for the Rev. Hon. C. J. Vernon, on the Lodge Farm at Grafton Underwood, was built from plans prepared by Mr. T. Easdale, of Pepper Arden, Northallerton, steward to Mr. Stobart. Mr. Davenport, of Kettering, executed the work last September in a very substantial way. The silo was constructed to hold 25 tons, and the work of filling it occupied several weeks. Rough grass which the cattle had left was put in first, and some aftermath was also used. The filling of the silo was completed on the 29th September. On the silo being opened in January it was found that the contents had sunk down about 3ft. 6in., leaving 6ft. 6in. of solid ensilage. The first three or four inches was rather mouldy, and not fit to use; but below this it was of excellent colour and odour. When put before some cows, although they had their ordinary quantity of food, they ate it greedily, and the carriage horses there took to it in a like manner.—*Live Stock Journal.*

REV. E. J. BIRCH'S SILO, OVERSTONE, NORTHAMPTON.

A number of agriculturists met on the Rectory Farm, Overstone, to witness the opening of a silo which Mr. Birch, the rector, had constructed last summer. The mixed seeds of 3½ acres of heavy soil were placed in the silo early in July, and the aftermath on the 26th of August. On Dec. 21 the ensilage was found to be in a very satisfactory condition, and almost entirely free from mouldiness.—*The Farmer.*

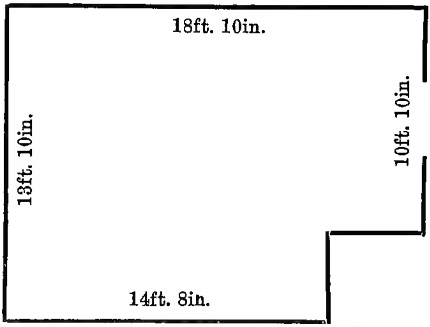
MR. J. SWAN'S SILOS, STONEFIELD, LINCOLN.

These silos are two in number, underground, 27ft. long by 7ft. wide, and 14ft. deep. The first 8ft. of excavating was through marl, and the last 6ft. through solid rock. The walls are built of 14in. brickwork in hydraulic lime mortar, and are faced with Portland cement. The cost (including 1in. boards, for covering the ensilage before weighting, and a set of 3in. boards to make floor above the pits) was 100*l.* 10*s.* 3*d.*, after deducting the price of stone sold.

The filling of No. 1 commenced on June 19, and the floor boards being used to raise the sides 2ft. 3in. above the floor, it was filled with grass up to 16ft. 3in. on June 23, when it was covered with the inch boards, and bricks put on to the weight of 120lb. per square foot. The grass was not cut into chaff, nor any salt put in, nor any straw or bran on the top of the grass. By July 9 the contents had sunk down 8ft. 7in. from the top, or more than half, and on the covering being removed, the grass appeared to be fresh up to the very boards. This time the sides of the silo were temporarily raised 4ft. above the floor line, and, when filled up, the cover and weight were put on for the second and last time. The cows fed on the ensilage have kept in capital condition, and the quantity and quality of milk and butter have been highly satisfactory.

SILO AT POOL FOOT FARM, SINGLETON PARK.

The building, of which the following is a ground plan, was formerly used as a cart house, but is now made into a silo. The walls are cemented



inside up to 8ft.; the floor, which is level with the ground, is also cemented. The roof is slated, and there is no drain.

On June 25, put in 6 tons 5cwt. of meadow grass (quite wet), covered up at night with ½in. boards, and weighted with 100 bags of sand, 126lb. each. On the 27th, put in 8 tons 15cwt. of meadow grass (fairly dry), covered up and weighted as before. On the 28th, put in 5 tons 3cwt. of rye grass and clover (quite wet), covered up and weighted as before.

On July 2, put in 4 tons 6cwt. of rye grass and clover (wet), covered up and weighted with 200 bags, 126lb. each, and 6 sacks of sand, 5cwt. each. On the 9th, put in 5 tons 5cwt. of rye grass and clover (fairly dry), covered up and weighted as before. On the 10th, put in half a ton of rye grass and clover in part where most settled. N.B.—None of the above were chopped, but put in same day as mowed. On the 27th, put in 4 tons 15cwt. of green oats chopped, covered up and weighted as before. No salt was used.

The quantity put in was, meadow grass, 15 tons; rye grass and clover, 15 tons 4cwt.; oats chopped, 4 tons 15cwt.; total 34 tons 19cwt.

The silo was opened on Dec. 7, when one cubic yard was measured and cut out, which weighed 80st. 12lb., or 42lb. to the cubic foot. A large quantity besides was also cut out. The weights were 126lb. to the square foot.

The chopped oats were the last put in, and there was nothing between them and the boards. You will see the top of the oats is a little darker in colour, but still good; and there was no mould on the top of the oats and the boards. There was no more moisture at the bottom of the silo than in the middle. The ensilage I have sent you in a box is cut right

from the top, the topmost portion being chopped oats, the middle portion rye grass and clover, put in whole, and the bottom portion being meadow grass, also put in whole, just in the same way as it came out of silo. My cows are now eating it greedily. T. H. MILLER.

Singleton Park, Poulton-le-Fylde, Lancashire, Dec. 10, 1883.

[The sample sent was in excellent condition, and developed a most pleasant odour after some hours' exposure to the atmosphere.—ED.]

MR. ECKERSLEY'S SILOS AT STANDISH HALL, WIGAN.

IN the summer of 1883, two silos were erected inside the old barn at Standish Hall, each 18ft. long, 10ft. wide, and 9ft. deep. The inside of the walls and the surface of the bottoms were plastered with a coating of Portland cement left smooth, and the corners were rounded off. The bottoms had a slight inclination from the sides to a channel in the centre. The channel also inclined slightly from the back to the front wall, where a small cesspool was formed, 12in, by 3in., and from this a lead pipe, 1in. in diameter, was inserted to convey the liquid which exuded from the ensilage through the front wall into a small well. At the commencement this lead pipe was plugged up.

Ten acres, statute measure, of second-crop clover and rye grass yielded 80 tons in eighty cart-loads of 1 ton each. Cutting commenced on Sept. 15, and continued at intervals until Sept. 29. The silos were filled alternately. One ton of old dry clover hay was spread at the bottom of each silo, in the expectation that it would absorb all the liquid which drained from the ensilage,

No. 1 silo was filled and pressed down as follows: On Sept. 15, fourteen loads clover and rye grass filled it to the top, and it was then left to subside: on the 18th, ten loads: 22nd, four loads; 26th, six loads; 28th, four loads; 29th, two loads—total, forty loads.

Between the dates, No. 2 silo was filled with forty loads in the same manner. The clover and rye grass was carted to the silos immediately after it had been cut. The cost in wages of cutting, carting, raking, filling, covering, and weighing, was 4*s.* 9½*d.* per load. The whole of the clover and rye grass was cut and put into the silos when the weather was fine, except one day when it was showery.

On Sept. 29 a layer of dry straw, about 3in. in thickness, was spread on the top of the clover on each silo. The straw was then covered with boards, and about 15 tons of stone were placed on the top of each silo. During the intervals of filling, each silo, when left to subside, was covered with boards and weighted with about 5 tons of stone. The ensilage gradually subsided, and at the expiration of fourteen days it had sunk in each pit from 9ft. in depth to an average depth of 6ft. 9in. At this time it was evident that the old hay at the bottom of each silo was not absorbing all the liquid which drained from the ensilage, and then

the plugs in the lead pipes were withdrawn, and about 40 gallons of liquid extracted from each silo. The liquid has been drawn off daily since then, but the quantity gradually lessened, and at the date of this memorandum very little drains off. There has been no further subsidence in either of the silos since Oct. 13.

On Oct. 29, No. 1 silo was opened, and the quality found to be good. Forty-two head of cattle (milch cows, in-calf heifers, feeding stock, and stirks) are consuming it, and all doing well. It is estimated that each silo will contain 30 tons of ensilage fit for use, besides the liquid.

The following analyses were prepared by Mr. Ralph Betley, the public analyst to the borough of Wigan. The samples of clover hay and ensilage which were analysed were both grown on the same field this year, the hay being the first crop cut at the end of June, and the ensilage the second crop cut in September.

Analyses.	Dried at 212° F. Hay.	Ensilage.
*Albumenoid substances soluble in water	2·87	7·55
†Albumenoid substances insoluble in water ...	7·83	4·89
Sugar, gum, and extractive matters	47·31	53·44
Fatty matters, chlorophyll, &c.	2·96	3·11
Indigestible woody fibre	32·84	22·16
Mineral matter soluble	2·51	5·71
Mineral matter insoluble	3·68	3·14
	100·00	100·00
*Containing nitrogen	0·46	0·28
†Containing nitrogen	1·25	0·75

Report.

The hay had all the characteristics of good clover and rye grass hay; the ensilage was much darker in colour than the hay, and was very odoriferous, having a faintly acid smell, accompanied by a very persistent smell of essential oils. The smell was entirely absent from the hay, and this difference will form one reason why the ensilage is so liked by the cattle. The analyses show, however, that besides this, a change is produced in the silo, due in great measure no doubt to the partial fermentation which is set up there, and which beneficially affects the food value of the product as compared with hay. This change results in:

1. An increase in the amount of soluble albumenoid substances or flesh-forming compounds.

2. A decrease in the amount of indigestible woody fibre, which of course means an increase in the total amount of digestible matter as compared with hay.

The liquid which drained from the ensilage was glutinous, slightly acid, and possessed a smell of essential oils, like the ensilage did. It may be mixed with food or drink for cattle or calves.—(Signed) Ralph Betley.

It is evident, from the results already ascertained, that the produce of an acre of clover and rye grass converted into ensilage will considerably exceed in value that which the same produce would if converted into hay. The system deserves the attention of the agriculturists of the United Kingdom.

N. Eckersley.

Standish Hall, Wigan, Nov. 26, 1883.

FARM OF THE COUNTY LUNATIC ASYLUM, MORPETH.

Having an exceptionally good second crop of clover, and the weather being very broken at the time it was ready to cut, Mr. Anderson, the farm bailiff, thought of storing part of it in a silo. He used for this purpose a small, oblong-shaped house, 14ft. by 7½ft., with walls about 9ft. high, and a cement floor, but the walls were left in their rough condition. He began to cut the clover on the 4th of October, with a fine morning, but afterwards it settled down into a wet day; the carting was proceeded with, however, and by evening twelve loads of wet clover were packed in the silo, covered with 1½in. boards, and weighted with 3 tons 12cwt. of pig lead. In four days, when it had sunk about 2ft., the boards were taken off, and the surface was found to be slightly hotter than the hand; but on piercing the mass with rods, the heat was nowhere found greater than at the surface. Seven loads of the same material, but in a dry state, were added and weighted as before. On Oct. 16 the weights were again removed, and four loads of clover, in which there was a good deal of rye-grass, were brought in direct from the scythe and placed in the silo. The whole was now re-covered, the pig-lead laid on, with an additional weight of blue-stone blocks, making in all 6 tons 4cwt., or 132lb. to the superficial foot. When the silo was opened on Jan. 2, the sinkage was found to be even from end to end, and that the mass of ensilage was just about 6ft. deep. A block measuring about a cubic yard of ensilage was removed. About 4in. on the top was found to be mouldy, but not much worse than is sometimes seen in hay badly got. The colour was everything that could be wished, and all were satisfied that, as far as look and odour went, the experiment was quite as successful as any they had read of. Most of the cows took it without hesitation, but some declined it; and only one horse would eat it. Mr. Anderson said he was satisfied with the result so far, and he would test its milk-giving qualities.—*Scotsman.*

MR. MASON'S SILO, KIRKBY STEPHEN.

Mr. Mason says: "The silo is a converted 'sink mow,' measuring 18ft. by 11ft., and 12ft. deep. The doorway from the cowhouse to the silo was closed with flags, and the whole surface of the walls and doorway covered with a coating of Portland cement about half an inch thick. The bottom of the silo is not cemented, but has a covering of straw. On the 31st July, about 3 acres of grass was cut and stored, a part being cut when it was raining. On the 2nd of August another acre was cut and stored, the first storage having settled about 3ft. The surface was then covered with eight lids, 4ft. 6in. by 5ft. 6in., made out of 1½in. boards, and stones to the weight of 150lb. to the superficial foot distributed over the lids. In the course of ten days the grass had subsided to about

7ft. On the 18th of December the stones were removed from the lid next the doorway, and a section 18in. wide was cut down. The top and sides of the ensilage were found to be mouldy about 6in. deep. This I attribute to the weight being heavier on the edge of the lid furthest from the walls, causing it to tilt, and so admitting air. We have been foddering ten animals on the ensilage for the past ten days, and with the most satisfactory result, the cattle eating it greedily."—*Live Stock Journal.*

MR. WILSON'S SILO, RIGMADEN PARK, CARNFORTH.

SIR,—I send you two samples of ensilage—one of chopped green oats, and the other of chopped meadow grass; and I should like to have your opinion on it, and to know how it compares with other samples, as mine was cut and put into the silo on as wet a day as ever rained on the face of the earth. It was a perfect wet squash when put in.

I first of all put a layer of grass, then a layer of oats, then another layer of grass, then oats, then grass. The top layer of oats and grass were not quite so wet as the others. I opened my silo the day before Christmas Day, and every beast I gave it to ate it greedily from the very first, although they had just been fed with their pulped turnips, chopped straw, and Indian meal: and they would not go on with their food until we left the place with the ensilage. I fed one lot of milch cows with it for a week, and they absolutely licked the flags perfectly clean, not leaving a single particle. I have put them back on to their old food, meaning to keep the ensilage until my turnips are done; and I shall find it very useful. I feed all my calves on it, and they eat it much better and more greedily than they used to do their usual food, and I am sure no calves can look better.

I have seen several samples of ensilage, but I have seen none so free from smell as my own, and shall be glad to hear your opinion. I believe the wetter it is put down, and the more weight put on it, the better it will be. I had no drain in my silo, and there is no liquid at the bottom. There is only about 1½in. to 2in. on the top not fit for cattle, but the pigs eat it readily, and about 2in. along one wall not quite so good, simply because we could not get at it to tread it properly. Along the other walls the ensilage is as good as the middle, so that there is literally no waste.

I intend to build silos for all my tenants who wish for them, on being paid a certain percentage on the outlay. Tenants cannot be expected to build them for themselves. I am so satisfied with mine that I am just starting to put up four silos under one roof, to hold over 200 tons each.

Rigmaden Park, Carnforth, Jan. 22, 1884. C. W. WILSON.

[Both samples were very good, and kept remarkably well; for there was nothing unpleasant in the smell and but very little mouldiness, after more than a month had elapsed.—ED.]

THE ROYAL AGRICULTURAL SOCIETY'S INSPECTION OF SILOS IN DURHAM AND NORTH YORKSHIRE.

[In the month of January last notices were published in the newspapers announcing that Mr. H. M. Jenkins, the secretary of the Royal Agricultural Society, would pay a visit of inspection to various silos in the North of England, and inviting those interested in the subject to accompany him. Lengthy reports of these visits appeared in the local journals, from which we extract the principal features—omitting, however, such details as are more fully given in the communications which had already appeared in the *Field*, and which are here reprinted at pp. 203 *et seq.*]

Mr. Stobart's Silo at Pepper Arden.

On Monday, Jan. 21, in response to the invitatiou, about fifty gentlemen met Mr. Jenkins on the estate of Mr. W. Stobart, Pepper Arden, near Northallerton. In addressing those present Mr. Stobart said that it was not necessary to go to any great expense in making silos, for on most farms there were old and disused buildings which could be easily adapted. Even limekilns might be turned to account. The building he used as a silo had been employed for holding straw and other things, and was 12ft. deep, and, having been adapted, was not an example of a building made for the purpose. He might say, however, that, if he were building a silo, he should put it above-ground, for that would be an advantage, inasmuch as, when you have to fill it, and it is necessary to lose as little time as possible, you have long days, and when you make use of the food the days are the shortest. Under the direction of Mr. Easdale 120 tons had been stored, and there was no waste of any description. It was chaffed before being put into the pit. He was satisfied as to the utility of this plan of storing food, more especially on strong land where turnips could not be grown. Of course he preferred a mixed food, and the beasts themselves preferred their food mixed. All that he wanted to do was to demonstrate that stock would do well on this kind of food without turnips.

A long and interesting conversation ensued, chiefly in the form of question and answer. Mr. Stobart said the temperature of the grass in the silo was never above 80°. The weight of the pitted food there was 57lb. per cubic foot. On the question being asked whether there was any drainage, Mr. Stobart explained that there was a little pit on the outside from which they had drawn off between fifty and sixty gallons of fluid, which was highly relished by the pigs, so much so that they would not have their dinner without it. They did not take wet days in preference to dry days in filling the pit, but the pit had been filled regardless of the weather, and it rained during the whole of the three days the men were at work. The fact was the crop must go in with all the juices in it, for when the fibre got comparatively dry it would not pack so closely together, and it should therefore be cut before it was dead ripe. Mr. Jenkins remarked that that was the universal experience; and Mr. Easdale

explained, in reply to an inquiry, that salt was not needed for the preservation of the food, which, he said was not pickled.

The preparation of the silo and the nature of the contents having been discussed, the question arose as to the comparative cost. It was estimated that 1 ton of ensilage cost from 12*s.* to 14*s.*, including rent; and that 75lb. of ensilage went as far as 95lb. of turnips and 25lb. of hay, in combination with equal quantities of cake and meal. Mr. Easdale, in reply to Mr. Jenkins, stated that what would cost 20*s.* in the cutting of hay would cost 24*s.* to cut, chop, and put it into a silo. On the other hand, the estimated value of the pitted food would be 3*d.* per stone, 2*l.* a ton, and to be equivalent hay should be 10*l.* a ton, so that there was a very great increase of value for the slight additional cost of pitted food. —Mr. Jenkins: Have you noticed any injurious effect upon the milk?—Mr. Stobart: None whatever—nothing like the taste you sometimes get from turnips. Besides this, we find the cows keep their milk better. I never found any taste whatever, and the butter also was unexceptionable. —*Newcastle Journal.*

Mr. Copley's Silo at Cowton.

The party next proceeded to Cowton to inspect Mr. Copley's silo. There is no drainage from the inside, but Mr. Copley stated that when they had cut down to within 3ft. of the bottom they found more liquid than they expected. A well was dug in one corner to the bottom of the silo, and from it 100 to 150 gallons of liquid was baled, and most of it given to the pigs. The silo contained about 15 tons, and an adjoining one, which had not been opened, 20 tons. The ensilage weighed 46lb. per cubic foot, and consisted of tares, clover with an admixture of wheat, clover fogg, meadow fogg, comfrey, and oats. They ate it with relish, except the large stalks, but did not like the comfrey. He gave the cows $1\frac{1}{2}$cwt. per day and 10lb. of boiled meal, equal to about $3\frac{1}{2}$lb. of dry meal. The yield of milk was improved, and the butter was both better in quantity and richness. The same system of weighting, &c., had been adopted as that used at Pepper Arden, but the materal was not chopped, and the ensilage had evidently been subject to a much greater degree of fermentation, the result being regarded as considerably less satisfactory.—*York Herald.*

Mr. Johnson's Silos at Croft.

On Tuesday, Jan. 22, Mr. Jenkins visited two farms, the first being that of Mr. C. G. Johnson, of Croft. In the first place Mr. Johnson conducted his guests to an old barn, 12ft. by 15ft., which he had experimentally converted into a silo. In July he filled this with meadow grass, which he compressed by means of a weighted lever beam, acted upon by an hydraulic jack. Finding his experiment successful, he determined to develop the scheme on a large scale, and with this view he erected a building specially for the purpose of a silo. [The details of structure of

the building and pressing apparatus are given more fully, with illustrations, in Mr. Johnson's letter on page 210.] Mr. Johnson showed the company two animals which, on the 14th of November, were very poor in condition, and which had been since fed on as much ensilage as they would take and a mixture of cake and meal, and these were compared with two of the same class of animals which were tied the same day, and which had been fed on the same mixture of cake and meal, and hay and turnips *ad lib.* Most people, he said, considered that the former were fatter than the latter, while they considered that of two lots of four that lot which was fed on hay and turnips were fatter than those fed on ensilage. He could not say that ensilage was superior to turnips and hay in fattening properties, but it was recommended by its cheapness as compared with the other class of food.—*Newcastle Journal.*

Silo on the Darlington Sewage Farm.

The Darlington Corporation Sewage Farm was next visited, and information respecting the silo was given by Mr. J. Burnside, the manager. It was constructed by erecting a partition wall across a barn, the wall being pierced by a door by which the ensilage could be removed as required. Its dimensions are 17ft. square; the floor and sides were cemented. Grass was put in to a height of 6ft.; the first portion was 19 tons, and a week after 12 tons were added. Very little heating could be discovered, and on opening tho silo for the purposes of this inspection the ensilage was found to be in most satisfactory condition. Drainage arrangements were made, but Mr. Burnside said that not a quart of liquid escaped. The ensilage was not wet, but contained sufficient moisture and possessed an agreeable odour. The mode of weightiug adopted is similar to that used at Pepper Arden; 19 tons were put on, or nearly 1½cwt. per square foot. Mr. Burnside regards the labour of weighting as a great drawback. The grass put in the silo was the produce of 7 acres, and would, according to Mr. Burnside's estimate, have averaged 1½ tons of hay per acre. It was cut in fine weather and placed in the silo unchopped and in capital condition. The grass was not off sewaged land. A little mould was perceptible along the outside. Some of the ensilage was given to the dairy cows, most of them ate it eagerly, while one or two refused.—*York Herald.*

Rev. C. H. Ford's Silo at Bishopton.

On Wednesday Mr. Jenkins and other gentlemen visited Bishopton, Stockton, for the purpose of inspecting the Rev. C. H. Ford's silo on the Glebe Farm, near the village. The silo [particulars of which are given at page 221] was constructed between April and June last, and cost 60*l.* 9*s.* 2*d.* This, however, was considerably more than the original estimate, the additional expense having been brought about by the incursion of water, which necessitated the digging of a well, and the tearing up of the concrete and cement floor of the silo, and the laying of

a drain thence to the well. The silo was filled between the 5th of July and the 30th of August, with about forty-three tons of good old-land grass, and in filling it Mr. Ford made use of neither salt nor bran, nor did he chaff the grass. The silo was opened in November, and Mr. Ford then commenced experiments in feeding cows. [Details of these experiments are given at page 224]. The conclusion come to by Mr. Ford was, not that ensilage was superior to hay, cake, and mangolds for feeding, but its principal virtue lay in its being so much cheaper than the latter mode of feeding, its cost being about one-half of a hay, cake, and mangold diet. Mr. Jenkins complimented Mr. Ford on the success of his operations, and said he observed less waste in this silo than in any other he had inspected. This he attributed to the careful manner in which the grass had been packed in the silo. The quality of the ensilage, he added, left nothing to be desired.—*Newcastle Journal.*

Mr. Hunting's Silo at South Hetton.

The party next proceeded to the South Hetton Colliery Farm, which is held on long lease by Mr. Charles Hunting, the well-known veterinary surgeon. The farm belongs to the Colliery Company, and they use a large portion of the land for their ponies and horses, leaving about 240 acres under cultivation by Mr. Hunting. The land is cold clay, and the district is swept by the keen easterly winds blowing from the sea, a few miles away, so that the place does not favour the production of late ripening crops. The silo was commenced in May, and was built at the cost of the owners of the soil, the tenant paying interest on the capital expended over it. The materials used for the walls are rough "post," or sandstone lumps, from the adjoining beds, laid in cement, whilst the inside is faced with a lining of brick. It was thought necessary to make the walls of great thickness, the other (or eastern) one is two feet thick, and the western side, against which it is intended to build a second silo chamber, is 2ft. 8in. in thickness. The walls are capped with sheets of corrugated iron, about four feet in height, and the roof is of that material. The silo is entirely above ground, and is 40ft. in length, 12ft. in breadth, and 10ft. in height from the floor to the top of the walls. In order to secure a good gradient for the transit of the ensilage between the chamber and the cattle house (a distance of about ten yards), the foundations were dug out 4ft., and the floor was laid down of heavy stones, over which a cemented top was placed. A line of rails is laid from the door of the silo to the cattle house, through which it runs by the central passage between two long rows of stalls. By means of a light waggon running on the rails, the ensilage can be supplied to the beasts with the greatest ease. A drain is run round the base of the silo, and a channel was made close to the door to receive the liquor which it was supposed would exude from the compressed grasses. The process of filling the chamber was provided for by means of a light wooden platform erected to the height of the brick wall on the eastern side of the building. The crops were carted to the side of

this platform direct from the fields, and were thrown into a chaff-cutter driven with a belt worked by pulleys, the power being supplied by a portable engine stationed fifty yards distant. As the clover, peas, &c., were reduced by the chaff-cutter, they were sent down a spout laid over the brick wall into the chamber, a section of the corrugated iron being removed for the purpose of making the opening.

Mr. Hunting commenced filling the chamber on Sept. 23 with the second clover crop from sixteen acres of land. The crop was a fair one, and was cut in dry weather. One day and a half was spent in the work, and the silo was filled to a depth of eight feet. As the cut clover was poured into the chamber, a draught horse, weighing 16cwt. was ridden about on the top of the stuff by a boy of six stones weight, in order that the clover might be thoroughly trampled down; but the animal could not be moved close to the walls or in the corners, and here a heavy man and three women were employed. When the clover had all been packed down, it was covered crosswise by a series of planks two inches in thickness and nine inches wide. Iron blocks, to the weight of twenty-two tons, were then distributed over the planks. The clover filled the silo to the height of 8ft. when the weights were placed in position, and it was then left for seven days, at the end of which period it had settled down to the extent of fourteen inches only. The weights and planks were then removed, and a second instalment of the charge was poured upon the top of that first put into the chamber. This material was twenty cartloads of beans, peas, and tares, which had been grown upon four and a half acres of land, together with the produce of a six-acre field of second-crop clover. The beans, peas, and tares were in wretched condition when put into the silo. The crop had been cut early in September for stacking; but wet weather set in, and it was soaked week after week, and so seriously damaged that Mr. Hunting elected to take his chance with it in the silo. The last of the clover was cut on a wet day, and taken direct to the silo. In all seventy tons of crops were placed in the chamber, and when the planks had been finally replaced on the top of the mass, they were covered with the twenty-two tons of iron blocks, and, in addition, with eight tons of sand, contained in guano bags, making altogether thirty tons, or 140lb. per square foot. The door of the silo was bricked up as soon as the weighing process had been accomplished. The expenses of carrying out the entire operation were as follows:—

	£	s.	d.
At the silo—			
Cutting the material, treading it down, and packing it	2	15	6
Weighting the silo with 30 tons of iron and sand; placing the weights twice on and taking them twice off	2	0	0
Fixing and fitting the chaff-cutter on the platform and taking it back to its original position	0	14	0
Enginemen and coals for driving chaff-cutter	1	2	0
In the field—			
Cutting, raking, and leading the crop to the silo (ten men and two women)	9	2	0
Total cost of the procedure	£15	13	6

The above sum, apportioned to a total of 70 tons of green crops, shows a cost of 4*s.* 6*d.* per ton. The operation of filling was concluded on Oct. 2, and the silo was sealed up the same day. It was opened on Dec. 19, and the contents gave out a strong but not unpleasant smell. The face of the ensilage was found to be grown with mould: and as the cutting allowed the two front corners and sections at the walls to be seen, it was discovered that in these parts the damage from mould extended from four to six inches into the material. The contents had sunk—almost entirely the second instalment of the crop—to the extent of 2ft. 10in.

There was a marked difference between the quality of the two layers of ensilage. Both were dark green in colour, soft, and full of juice; but, whilst the last instalment was but slightly aromatic and had an acid odour, the first instalment—that at the bottom of the silo—was very sweet, and exhaled also a decidedly alcoholic aroma. A square foot of the second instalment weighed 40lb., whilst a square foot of the first weighed 50lb. About six feet of the face has been removed, and the extent of moulded substance at the sides remains the same as at first. There is no mould at the top. When the receptacle provided for the leakage of liquor from the ensilage was opened, it was found to contain a very small quantity, somewhere about three gallons, of liquor.

As soon as the chamber was opened, 10lb. per diem of the ensilage was given to each of thirty-six fatting cattle. Six milk cows received 28lb. each per day, and twelve head of yearling cattle were supplied with the moulded and inferior material from the front and sides of the stack. The refuse ensilage was thrown indiscriminately to the young stock, and they ate of it about 10lb. each per diem, or about two-thirds of the quantity supplied. They did not fancy it at first, but nothing else was given to them, and they quickly took to it. They have had nothing else since, and they have continued to do very well.

The experiment with the milk cows bore at first a very disastrous appearance. They received 28lb. each of ensilage (from the last instalment, it should be noted) with their usual crowdies twice a day. They became seriously constipated in their bowels, and by the fifth day of the new feeding the supply of milk given by each cow had fallen off to the extent of one-half, whilst the milk remaining was no richer than it had been before. Forthwith the quantity of ensilage given to each cow was reduced to 14lb. per day, and to the diet was added 14lb. of pulped turnips. The effect of this step was marked. In two days the milk given by each of the cows was brought back to the quantity yielded previously to the introduction of the full ensilage diet. The mixture of one-half ensilage and one-half pulped turnips was given to the cows until a week ago, when the proportions of the feed were altered to two-thirds ensilage and one third pulped turnips. The stock have continued to do perfectly well on this mixture, and the milk yielded is the usual quantity, whilst in its quality not the smallest difference can be detected as compared with the pre-ensilage period. It is neither richer nor poorer.

Perhaps the most interesting of the feeding experiments is that conducted with six in-calf heifers, kept free in a stock-yard, and two tied up in stall. These heifers get nothing but ensilage, and a little whole oat straw at nights. They were put upon this diet on Dec. 19, and they have all along been in very fine conditiou. The six in the open yard show good coats, bright eyes, and active motion in moving about. The two in the stalls have done, if possible, a shade better than the six outside. One noticeable feature of the change of habit in the six heifers induced by the all-ensilage diet may be mentioned, although the feature is demonstrated in some degree with all the stock fed on the substance in part, namely, a strong tendency to drink considerable quantities of water. Directly the six heifers are let out of the yard each morning, they march direct to the pond and drink their fill. The stall-fed animals also clearly enjoy a good drink of water, and slight thirst and constipation evidently proceed, in this case, side by side with the ensilage feeding. The thirty-six fatting cattle receive only one feed of ensilage per diem, namely, their morning meal, supplied at six o'clock. This consists of 14lb. of ensilage, and the animals also receive afterwards pulped turnips, straw, and meal. They did not do very well for the first few days of the change, but they quickly picked up their leeway, and learnt to eat the ensilage with evident relish. Their progress has been highly satisfactory. The horses have steadily refused, so far, to have anything to do with the ensilage, and the sheep on the farm have been quite satisfied with a mouthful of the substance.—*Newcastle Journal.*

MESSRS. BRODERICK'S SILOS IN WENSLEYDALE.

On Thursday Mr Jenkins intended to have visited both Hawes and Harrogate, but, owing to a communication having been received stating that the silo at the latter place had not been opened, the party did not proceed thither. On arriving at Hawes the visitors were welcomed by Mr. G. Broderick, one of three brothers who are among the first tenant farmers who have constructed silos. Mr. Broderick has long been known as a scientific farmer, and four years ago he was chosen as one of a deputation to visit Canada and report upon it as a field for emigration. Mr. J. L. Broderick, who is in partnership with his brother at Hawes, and Mr. Luther Broderick, of Summer Lodge, Swaledale, shortly afterwards joined the party.

Before proceeding to inspect the silo at Hawes, Mr. Luther Broderick exhibited a specimen of ensilage which he had brought from Summer Lodge. The silo from which it had been taken was made out of an old barn which stood on a hillside—it measures 16ft. high by 14ft. square, and its construction did not cost more than 10*l.* or 11*l.* In August this silo was filled with meadow grass, the produce of about eight acres. The work of depositing the grass occupied two days, after which turf or grass sods were placed on the top—the grass side downwards—and upon these were placed stones weighing a little more than a hundredweight to the

square foot. The silo was not opened until November, when the ensilage was found to be in capital condition. Since that time the cattle have been constantly fed on it, and have appeared to thoroughly enjoy it. They were mostly young animals, and the result has been very satisfactory. The grass was unchaffed and dry when put in the silo, and there was a small quantity of liquid at the bottom of the silo, and the effect of that was that the cattle did not eat so much of that ensilage as of the dryer, nor did they show the same desire for water. Upon examining the sample of ensilage produced, all agreed that it was in a very good state of preservation. Mr. Jenkins said the success of the experiment appeared to him to depend upon preventing the alteration of the fodder, for when they got it into a sodden state they, of course, made it into a sort of pickle. The sample produced was damper than hay would be, but otherwise it was not very much altered. He had seen dryer ensilage, but none less changed in condition. Mr. L. Broderick remarked that there was about three inches waste on the top—next to the grass sods—and about six inches waste next to the walls. It appeared to have kept best against the dampest wall.

The party then proceeded to the silo belonging to Messrs. J. L. and G. Broderick, which was situated on the side of the hills about half a mile from Hawes station. Like that in Swaledale, this building had formerly been an old barn, but had been converted into a silo at a cost of about 50*l.* [Details are given in Mr. G. Broderick's letters, pp. 216 and 217.]

The produce of about fourteen acres of grass land was deposited unchaffed in this silo in July. Only one half of the silo had been opened, and upon examining the ensilage it was found that there was more waste at the ends of the boards than next to the side wall, and this was thought to have arisen from the fact that the boards, not fitting close up to the walls, allowed the grass to rise a little and admit the air. Mr. Jenkins drew attention to the wet state of the ensilage, which he said was a little remarkable. Mr. G. Broderick remarked that there was a lot of water in the grass when it was good. Mr. Jenkins said the ensilage in the centre of the silo was much dryer than at the sides. Mr. G. Broderick said that was somewhat difficult to explain. While trying to weight all the ensilage in that silo to the same extent they had taken care to put the heaviest weights at the sides. In some instances, however, they found it rather hollow in the middle, and that had allowed the ends to be drawn away from the wall, and thus space was left by which the air penetrated.

The company were then shown nine cattle—five milk cows and four in calf, and which are expected to calve in spring—all of which had for some time been fed only on ensilage. On that food they had improved considerably. In answer to Mr. Jenkins, Mr. G. Broderick said he was at present trying the experiment as to the merits of ensilage as cattle food, but after he had satisfied himself on the subject he would give the cattle a mixture of food, because he thought it preferable to feeding them continually on one kind of fodder.—*York Herald.*

Major Cochrane's Silo, at Aldwark Manor.

On Friday, Mr. Jenkins visited Aldwark Manor, where Major Cochrane has erected a brick silo, the interior dimensions of which are 24ft. by 9ft. Into this grass was put on the 1st of August, to the depth of 13ft. The grass was gathered in fine weather, and after being trodden was covered by a layer of straw, on which were put boards and pig iron weights as at Pepper Arden. The ensilage cut out was in good condition, though there was some waste at the sides of the silo. The pressure was 168lb. to the square foot, and the weight of the ensilage per cubic foot was about 50lb. average. There was a little salt put in, but Major Cochrane thought this was not desirable, as it made the cattle unnaturally thirsty.

Mr. Wood's Silos, at Clifton, York.

The party then went to Clifton, to inspect Mr. Wood's silos. These are 15ft. by 10ft., and 11ft. deep. One was empty and the other had only been recently opened. The material put in was grass and clover, and the ensilage was weighted with several layers of bricks, the pressure being nearly 1½cwt. to the square foot. Mr. Wood stated that he put salt in the grass, and also the clover in one of the silos, but not in the clover of the other, and he found the latter equally as good as the salted clover. There was very little that was bad on the sides, and about 2in. on the top. The silo was not drained, but he had pumped about 20 bucketfuls of liquor out of it. The grass was gathered in fine weather, and he estimated that it cost him 34*s.* an acre to put in the silos, and that the yield was 5 tons per acre. Some of the ensilage was given to the cows, which ate it with evident relish, and Mr. Wood said they throve on it.—*York Herald.*

Lord Londesborough's Silo.

The silo that was next visited was that of Lord Londesborough, at Londesborough Park Farm, near Market Weighton. The party was conducted by Mr. Young, and special attention was called to the butter made from ensilage fed cows, and this was pronounced excellent. The silo was made in July last, in the end of the barn. Its dimensions are 13ft. by 8ft. wide, and 10ft. 6in. deep; calculated when full to hold about 15 tons of ensilage, and the cost of brickwork and cement was 12*l.* Arrangements were made to drain any liquid from the silo, and a tap was carried through the wall to the outside of the barn, but this proved unnecessary, as nothing has drained from the ensilage since it was put in. The silo was filled with grass from the cricket ground adjoining, from the 20th to the 30th of August, stored dry and well trodden down as it was put in. The weights consisted of pig iron blocks 1cwt. each, laid on 1½in. boards, hollowed at the joints; these were removed when next filled and replaced as before. The weight used averaged about 1½cwt. per square foot. About 3 stone of salt was sprinkled over every ton of grass. On the 17th of November

the silo was opened, and the contents were found to be in a satisfactory condition, with but little waste on the top. The cattle, pigs, and horses that had the ensilage given to them ate it readily.

To test the value of ensilage as compared with other foods, four cows were selected and tied up in the same house, and from the 1st of Jan. to the 10th, each had 18lb. hay, 3lb. choppy, 10lb. ground oats, 14lb. mangold, and 3lb. cotton cake, or 48lb. each cow. The milk was weighed after every meal, morning and evening, with a total result from the four cows of 1095lb. of milk for the ten days.

From the 11th to the 20th of January the same cows had 28lb. ensilage, 14lb. mangolds, 3lb. cotton cake, 10lb. ground oats (55lb. each cow), and the total weight of milk given by the four cows at the end of the ten days was 1116lb. showing an increase of 21lb. in favour of the ensilage.

It was thought better to do away with the roots altogether, as one of the cows was slightly purged; consequently from the 21st to the 25th the following food had been given:—10lb. ground oats, 3lb. cotton cake, 5lb. maize meal, 32lb. ensilage (50lb. each cow), with very satisfactory results; in five days 578lb. of milk, which, if continued for the ten days, would give an increase of 61lb. over the first ten days. A cubic foot of the ensilage had been weighed and found to average 31lb.—*York Herald.*

Mr. Ashforth's Silo, Longley Hall, Sheffield.

On Saturday, Jan. 26, Mr. Jenkins paid a visit to Longley Hall, to inspect Mr. Ashforth's silo. It is formed out of an old shed, built of stone, on the side of a hill, and is 14ft. long, 8ft. wide, and 9ft. deep, with cemented walls and flag-stone floor; the cost of alteration amounting to 9*l.* It was filled on three days in August, at intervals of a week, a little salt being added (abont 4lb. to the ton), and the boards and weights put on each time. The weights were 10 tons of steel ingots, of 50lb. each (brought from Mr. Ashforth's works), giving a pressure of about 2cwt. per square foot. Some chopped vetches that had been siloed came out in capital condition.

MR. NEVILE'S SILO, SKELBROOKE, DONCASTER.

The dimensions of the silo which Mr. Percy Nevile has had constructed in Skelbrooke Park are 15ft. by 11ft. 10in. It is plastered with Portland cement, and has no drainage. It was filled on August 22, 1883, with second crop rye-grass and clover, sixty-seven cartloads being put into the silo. It was three times filled to the top, and when opened, on Jan. 4, it had sunk 3ft. 6in. It was covered with boards 1½in. grooved and battened, and weighted with 16 tons of rough stone. There was very little mould at the top, and none at either sides or corners. All the stock ate it most greedily the first day it was opened.

THREE YEARS' EXPERIENCES IN WALES.

[Under the head of "Experiences of a Tyro," Mr. Kenyon gave in the *Field* of July 22, 1882, the following account of his first year's doings. He is now one of our "veterans," and has supplemented his early experiences by the results of two seasons' further practice.—Ed.]

My attention was first called to the subject by reading accounts of its successful practice in the United States, as described by various correspondents of the *Farmers' Review*, a capital little paper published at Chicago, and sent to me by a friend in Illinois. Accordingly, while waiting for the weather to clear up for haymaking last summer, the men were set to work to dig a large and deep pit in the stackyard, near the edge of a bank which dipped abruptly down to a stream below. The subsoil here appeared to be a stiff clay, and this, in addition to the favourable situation for drainage, constituted one of the chief reasons for selecting the spot as the site of my silo, as it is called.

I hoped that the clay might prove sufficiently firm and cohesive to enable me to dispense with a lining of stone or brickwork. Such, however, was not the case; for, after getting down to a depth of eight or nine feet, the sides, owing probably to the heavy and continued fall of rain, commenced to slip in here and there. A facing of brick or stone work was absolutely necessary, and accordingly two or three truck-loads of common red bricks were procured, and masons engaged to lay them in cement and sand, mixed to a proper consistency with water. The facing was only one brick thick on two sides and part of the third, but where the sides showed the greatest inclination to cave in, two courses of bricks were laid. Great care was taken to form the pit perfectly rectangular, and to carry the walls up plumb, in order that the lid, to be described presently, might not be prevented from moving evenly downward as the contents subsided. At each of the four corners the brickwork was continued upwards in the form of pillars, to support a light roof. When completed, the dimensions of the silo or vault (inside measurement) were as follows: Length, 11ft. 9in.; width, 10ft.; and depth, 11ft.

I ought to mention that, a little water having been met with near the bottom of the pit, the foundations of the four walls were made to do duty as drains likewise, by the expedient of placing the bricks of the lowest courses on their edges, so as to leave a space of about 2½in. between them. The next course being laid over, and at right angles to them, formed a cover to the narrow gutter or drain thus created, and on this the brick wall or facing was built. An outlet for the water was made by cutting a short drain (afterwards tiled and refilled) from the stream already mentioned to the lowest corner of the foundation. Slate flags laid on mortar, and joined together with cement, formed a good floor to the pit, which by this means was kept quite free from water, without

allowing any air to leak in from the drain—a most important matter; indeed, my excuse for entering so minutely and at such length on the construction of the silo, is the paramount necessity of making it thoroughly air-tight; in fact, this is one of the main conditions of success.

At last, on the 24th of September, 1881, after many interruptions to the work by reason of the very unsettled weather, which caused the hay harvest to "drag its slow length along" from the beginning of July to the end of September, all was ready, and we commenced to fill the large tank-like receptacle with cut grass from some four or five acres of good meadow, which had been reserved for the purpose, and which, from being shut up so long, was a very heavy crop. The grass was mostly cut by a two-horse mowing machine, and at once collected into heaps or cocks and carted home. Here it was cut up by a Bentall's chaff-cutter, geared to one inch cut and driven by water power, as fast as three or four men could feed and clear away from it. Other men, provided with large baskets or hampers, carried the cut stuff away to the silo, where it was spread evenly about and well trampled down by a woman and three or four boys, with now and then the assistance of an extra man or two when the grass was being thrown in very rapidly. In this manner about nineteen cartloads of grass were stored away. The lid or cover was then put on. This is constructed of 1½in. planks, and made in sections of about 3ft. 10in. in width; the planks ploughed and grooved and strongly battened, with the battens projecting, so as to overlap and cause all the sections, under equally distributed weight, to move downward together. A quantity of spare bricks were deposited equally over the surface of the lid, and the whole left to settle down. In a couple of days the green stuff had subsided considerably, and by fixing up a sort of movable frame of planks around the top of, and flush with, the brickwork, we were able to cram in seven loads more grass. The lid was then finally put on, and brickbats and stones heaped on top to a considerable depth—probably three tons weight. When the mass had settled down below the level of the pit mouth, the temporary frame was removed. Thus, twenty-six cartloads of grass, estimated to weigh from twenty to twenty-four tons, were pitted by Oct. 4.

Although most of my friends took a kindly and even enthusiastic interest in the experiment, such an unusual method of preserving grass for winter consumption was looked upon by many of my less educated neighbours as the height of folly, and their remarks on the whole proceeding were far from flattering or encouraging. It was not without some display of firmness even, that my own men could be induced to commence digging the pit—partly, no doubt from a laudable desire to save their master's credit, and partly, perhaps, from fear of themselves sharing in the ridicule which the project would be likely to excite. Curiously enough, though the prophets of evil all predicted the certain failure of the experiment, they were by no means so unanimous as to the cause of failure; for while some maintained that the grass would be sure to heat and take fire, others as confidently asserted that it would be sure to rot

and turn to manure. One of the extra hands, who was assisting to throw in the cut stuff, remarked to the foreman that "he was not very well off, but he dare bet the master all the money he had that the grass would all be found perfectly rotten when the pit was opened in winter!"

As it was so late in autumn when the silo was filled, we did not open it until Feb. 6, 1882, an interval of rather more than four months, in order to give the plan a thorough trial. At last the eventful moment arrived, and as the men commenced to raise the section of the cover, we noticed some dark mouldy-looking stuff ronnd the edges; whereupon my honest Welsh foreman, who had hold of one corner of the lid, ceased lifting, and at once began to bring to my remembrance how he had always warned me that the grass would be sure to "spooil." "It certainly does not look very encouraging, so far," I said; "but lift the lid right off, and then we shall see what has happened to it." In a few moments the heavy section was completely removed, and then a loud exclamation of "Well, *diawk!*" from the man expressively announced his astonishment at perceiving the true state of affairs. Except for a little distance round the sides and about the edges, at top, the grass was perfectly preserved, and little change in appearance from what it was when pitted. On being handled it gave out a strong though not unpleasant odour, reminding one of the smell of steamed hay, only more pungent. Cattle quickly took to it, and, as they became more accustomed to its peculiar flavour and smell, appeared to relish it greatly.

Although no trial was made of the feeding value of ensilage in comparison with hay or other fodder, we were satisfied that it was a wholesome and useful kind of food for cattle of any age. A lot of yearling calves were particularly fond of it, and seemed to thrive well on the preserved grass. Milk cows were found to require a little cotton cake, bean meal, or other concentrated food in addition, to keep up the quality of the milk and make rich cream. On the other hand, the butter had more of the colour, if not flavour, of that from grass-fed cows, than was the case before using ensilage.

There was one drawback to the complete success of the experiment; the edges of the mass of cut grass were mouldy and unfit for food, for a thickness of several inches from top to bottom of the pit. In some parts not more than an inch or so next the brickwork was spoilt, while in other places the damage extended to a foot in width. There are two theories which might perhaps be advanced to account for this state of things. First, that the pit is in too damp a situation; and, secondly, that the brickwork, being only pointed and not covered with Portland cement, may not possess a sufficiently smooth surface to insure the regular settlement of the contents. I incline to the latter as the most plausible conjecture, and it is borne out by a statement of M. H. Cottu's (of Indre-et-Loire, France) in the *Agricultural Gazette* last year. He says, in describing his pit, "the sides are perfectly vertical, the four corners being slightly rounded; the whole is coated with Portland cement, thus insuring a

perfect settlement of the contents, upon which depends the preservation of the fodder." Probably, however, it is the two defects above-mentioned, conjointly, that cause the mischief in this case. To remedy one of them, at all events, I purpose having the brickwork coated with cement before proceeding to refill the pit. Unless a perfectly dry gravel or sand bank is to be found in a convenient situation for the proposed silo, I am convinced that it would be better, in a comparatively damp climate like ours, to construct it entirely above ground. I will only remark in conclusion, that, as the process becomes better understood, it must prove of considerable advantage to owners of stock in Great Britain, as it has already done elsewhere. When it is considered that, by such a simple process, the heaviest grass or other forage crops can be preserved for winter use in the wettest of seasons, its value is plainly perceived C. R. Kenyon.

Brynllwydwyn, Machynlleth, July, 1882.

Sir,—Two season's further experience of ensilage has more than ever impressed me with its value, not only as a cheap and effectual method of securing forage crops in any weather, wet or dry, but also of providing wholesome and succulent food for stock, and one which they greatly relish.

In order to perfect my silo, and, if possible, avoid the waste which had taken place around the walls—as described in the account of my first experiences (*The Field*, July 22, 1882)—I had the inside coated with cement before proceeding to refill the pit in 1882. The result was most satisfactory, for, although the grass was nearly all mown, carted, and pitted in extremely wet weather, there was scarcely any mould to be seen when the shutters were removed on the 12th of January following. Haymaking, on the other hand, had, during that same season, been a most tedious and expensive business. It is said that an ounce of fact is worth a bushel of theory; I will therefore append a few facts which afford a striking illustration of the value of ensilage in comparison with the usual method of harvesting in a bad season like that of 1882.

At the same time that the silo was being filled with coarse herbage from a poor sideland field, we were endeavouring to save a crop of hay from an upland meadow, very favourably situated for drying in ordinary seasons. When the sun shone out for a brief season, all hands repaired to the hayfield; when clouds and rain prevailed, they resorted to making ensilage. In the one case, in fact, we "improved each shining hour;" in the other we utilised each wet and cloudy one. Yet, strange to say, the measure of success was in precisely inverse ratio to the care and expense bestowed. The hay—badly weathered in spite of all our efforts—was only used, because only fit, for bedding the cattle, which were actually fed upon the ensilage already described, ensilage composed of the coarsest kind of herbage, and carried cut into chaff, and pitted regardless of the rain. And, what is perhaps quite as remarkable, the animals grew and throve remarkably well during the three months they were fed upon this

rough description of ensilage. Sheep, however, would not eat it unless starved to it, although horned stock would take it in preference to hay. So much for my second (1882-3) experiment.

My third and latest trial was conducted on somewhat different lines. Hitherto I had always cut the grass into chaff before packing it into the silo; but last year (1883) I pitted it long, just as it came from the field. This plan, than which nothing could be more simple, has answered perfectly. The ensilage, although mostly put in wet, like the previous years, is, to say the least, quite as good as any that has gone before it. Cattle eat it greedily, and even sheep will take it in preference to good hay. Until this last year I had never succeeded in getting the latter class of stock to take freely to ensilage. Now, however, both breeding ewes and yearling sheep, Shropshire Downs and cross-breeds, eat it readily.

There is a decided gain in not cutting the grass into chaff, as it saves unnecessary handling, which means increased cost of manufacture; although in cases where the proper machinery already exists, and where the chaff-cutter can be placed directly over the silo, it might be economical to chop up the fodder on account of its packing closer at the time, as much grass can be packed into a silo of any given dimensions when thrown in long as when cut into chaff, but it will require the operation of filling to be oftener repeated in the former than in the latter case. For my own part, although I have water power and chaff-cutters, I don't intend to chop up my grass in future; for, besides the saving of expense, there is less waste in handling the unchaffed ensilage. In this condition, too, it can be supplied to stock in either racks or troughs, whichever may be most convenient.

With respect to salt, a good deal of misapprehension seems to exist. Its liberal use is evidently regarded by some as indispensable to the production of good ensilage. I held much the same opinion three years ago, but it has been dispelled by experience. I should say that if this substance exerts any influence at all on the process, it is certainly not a beneficial one. As a condiment or a corrective I believe it is a good thing for stock, but I prefer to give it them separately, in the form of rocksalt, which they can lick or not, as their tastes or instincts prompt them. In 1881 I mixed a considerable quantity of salt with the grass as it was thrown into the silo; in 1882 I only did so with about half of the ensilage; and last year I discarded it altogether. If the quality of my ensilage is no better in consequence, it has certainly suffered no deterioration by the omission.

When as much as 2lb. of salt is recommended to be added to each hundredweight of fodder, it is time to cry, Hold! At that rate, in eating 50lb. or 60lb. of ensilage, a beast would daily consume 1lb. of salt—a quantity almost sufficient to form a brisk purgative. This must surely be too much of a good thing. CHARLES R. KENYON.

Brynllwydwyn, Machynlleth, Feb. 28, 1884.

MR. OAKELEY'S SILOS, TAN-Y-BWLCH, MERIONETHSHIRE.

THE home farm of Mr. W. E. Oakeley, of Plas Tan-y-Bwlch, is situate in the far-famed "Vale of Festiniog," on the banks of the river Dwrydd, and has, during the last fourteen years, been much improved by embanking and underdraining, thus converting the originally poor and peaty soil into sound pasture and arable land, chiefly the former. A few years ago the soil was so soft that it was with difficulty cultivated; but, by thorough draining, it has become comparatively firm and sound, producing good crops of hay, oats, and roots. Being determined to give ensilage a fair trial, Mr. Oakeley instructed his farm bailiff (James Maitland) to prepare three silos on different principles, under his personal supervision.

Silo No. 1 was formerly a mixing bin in the barn, 7ft. square by 7ft. deep, formed with slate slabs to the height of 5ft., with an addition of 2ft. of deal boarding. On June 2 this was filled with grass from the lawn in front of the mansion, well shaken and trodden evenly over the silo, then covered with rough slabs from the saw mill, and afterwards weighted with common stones to the extent of 190lb. to the square foot. In two days it sank about two-thirds. The weights were then removed and the silo refilled; the slabs and stones were replaced, and the silo closed up at a cost of less than 20*s.*

Silo No. 2 was formed at the back of an existing cattle shed, and excavated along the same 24ft. by a width of 13ft., and to a depth of 10ft. The walls were of rough masonry, and lined with concrete $\frac{3}{4}$in. thick at the sides, and 4in. at the bottom, the whole covered over with a wooden roof resting on six pillars, $3\frac{1}{2}$in. in height from the coping of the walls. This was executed at a total cost of 45*l.* 15*s.* 3*d.*, including weighting and cartage. This silo was filled, on June 29, with grass from part of the pasture land before described to the height of $2\frac{1}{2}$ft. above the coping stones; a layer of heather was then put over the grass and covered with wooden slabs, then weighted with waste blocks of slate to the extent of 172lb. to the square foot. The grass sank in four days over two-thirds. The weights were then removed, and stacked on top of one side and end of silo walls. The silo was then refilled, and underwent a similar operation, which was repeated eight days afterwards, this being the third and last time the silo was filled. There were seventy-two cartloads of grass (weighing about 15cwt. to the load), or 54 tons, put into this silo. The process of lifting the 24 tons of slate blocks by nine men took forty-five minutes each time, and the whole cost, including horse labour for mowing and carting, came to 4*l.* 8*s.* 3*d.*, or 1*s.* $7\frac{3}{4}$*d.* per ton. The second time this silo was filled it was raining hard; the grass was quite wet, and was put into the silo during weather in which nothing could be done at haymaking. The grass was carted direct from the field to the silo, and was not chopped; neither was bran, straw, salt, nor anything else mixed with it.

Silo No. 3 is an excavation in the stack-yard, 10ft. long by 5ft. broad and 10ft. deep, dug from a marl subsoil, with no other preparation whatever. The digging was done at a cost of 12*s*. This silo, or rather hole, was filled in September with fourteen or fifteen loads of coarse grass, which the cattle would not depasture, then covered with rough slabs and weighted with common stones to the extent of 215lb. to the square foot, and covered over with a temporaty thatched roof.

On Dec. 8 the stones were removed from part of No. 1 silo. The ensilage was cut from top to bottom, and the quality proved excellent; some 6in. at the top and at the sides was of inferior quality, but it is here worth recording that where the ensilage was encased by the slate slabs the condition was perfect. I witnessed the ensilage given to Mr. Oakeley's herd of pedigree Welsh cattle, and nine out of every ten cows ate it with avidity. The horses were at work during the opening of the silo, but the bailiff informs me that when they returned three out of five ate it at once, and the other two have since taken it readily, mixed with chaff. The ensilage has every appearance of being very wholesome, nutritious food, having all the healthy feeding succulent properties of midsummer grass, with a pleasant and appetising flavour.

On Dec. 11, No. 2 silo was partially opened for the purpose of ascertaining the quality of the ensilage, for our guidance in dealing with the question of spring food for the cattle. This I also witnessed; and within a few inches from the surface-covering of heather the ensilage was in a perfect state of preservation, and sent forth a most pleasant aroma. The cattle also ate the contents of this silo very greedily the moment it was put before them. Success being assured, this silo was closed up for spring food. A. M. Dunlop.

3, Old Palace-yard, Westminster Abbey, Dec. 12, 1883.

James Maitland, the bailiff, has since kept a very correct record of the milk and butter produced during the consumption of the ensilage from No. 1 silo, and he informs me that the quantity and quality were both very considerably improved, especially the colour of the butter; and this became more visible when the ensilage was exhausted, and the cows put back to their usual food.

Silo No. 3 was opened on January 9, the result being that the coarse grass in this primitive silo was rendered fit food for cattle. It was no doubt of a more rancid nature than the ensilage in silos Nos. 1 or 2, but when cut and mixed with hay the cattle ate it very well.

As will be observed, No. 2 silo was only partially opened on Dec. 11, and, as stated above, was closed and left for spring food. To-day (March 1) the ensilage was cut from top to bottom, the result being that the quality of the same throughout was highly satisfactory. Within a few inches from the heather the ensilage gave forth a most pleasant aroma, perhaps a little strong, but when it was cut down two or three

feet it became perfectly sweet. At about four feet from the top a layer of vetches 9in. thick was cut through; the smell from this was rather strong, and the cattle did not seem to care for it. Immediately below this, and down to the bottom of the silo, the quality of the hay ensilage remained sweet and succulent, and the stock ate it with avidity. A curious feature presented itself from 5ft. to 10ft. down; the white clover had not lost its bloom, nor the buttercup its yellow tinge. The ensilage is of good quality close up to both sides and ends.

One hundred and eight gallons of liquid were drawn from this silo by means of a common tap during the first ten days it was being filled. The liquid resembled strong tea, and was given to the cart horses, mixed with hay chaff, and they seemed to like it very much.

Tan-y-Bwlch, Merionethshire, March 1, 1884. A. M. DUNLOP.

MR. EVANS'S SILO, PWLLHELI, CARNARVONSHIRE.

AN experimental silo on a small scale has been built in South Carnarvonshire, by Mr. Owen Evans, of Brownhall, Pwllheli. It was of plain stone work, 12ft. by 9ft. inside, and 10ft. to the corbel, the floor of concrete, and walls cemented 8ft. from the ground; so that it is thoroughly watertight, with no opening except in the upper part of the gable end (15ft. by 4ft.), it being let into a sloping side land convenient to the grass. The walls of the building are 2ft. thick, with slate roof.

Between July 24 and 28 there was carried into it eight cartloads of coarse grass grown under trees, and what was cut along the fences of the hay fields; also some rough refuse pasture, and over a cartload of green nettles. The whole was carted wet or dry as soon as cut, and carefully trodden down by two men as it was brought in; and, there being no room to lay in any more, it was closed in by laying 2½in. planks of home timber placed across the building, and weighted with from 5 tons to 6 tons of stone. The silo was again opened on Aug. 9, as it had subsided to about 3ft. of the bottom, and from that to the 13th seven additional cartloads were put in, when it was finally closed upon fifteen cartloads.

When opened on the 3rd of March the ensilage proved fully equal to anticipations; the cattle, young and old ate it with avidity, and the cowman says they prefer it to the best of hay.

COLONEL LAMBTON'S SILO, BROWNSLADE, PEMBROKE.

COLONEL LAMBTON, of Brownslade, near Pembroke, opened a "silo" on Dec. 19. The silo was 12ft. by 9ft., in two compartments. The contents had been carried in very wet weather last June, and were half meadow grass and half clover. The temperature when the place was entered was found to be 92°, and the ensilage was in splendid condition, particularly the clover.—*Daily Telegraph.*

MR. POCHIN'S SILOS, BODNANT.

Two silos have been erected at the home farm of Mr. H. D. Pochin, of Bodnant Hall. The site chosen was near the farm buildings, where the ground forms a steep gradient, so that the upper ends of the silos are level with the ground, which greatly facilitates the work of filling. Each silo measures 24ft. long, 9ft. wide, and 12ft. deep; the walls are 2ft. thick, and built of stone and mortar, lined with cement. A doorway 4ft. wide leads into each silo, and before being filled with grass both doorways were made up with railway sleepers, and the joints filled with clay and moss. A 2ft. wall separates the two silos. At present the silos are roofed temporarily, so that the exact total cost cannot be given, but the sum will be about 85*l.* The construction and filling of the silos were superintended by Mr. Stewart. From Aug. 10 to 20 both silos were filled with newly-cut grass, trodden by cart-horses. A thin layer of straw was placed on the grass, and then old railway sleepers, laid crossways and closely packed together, were weighted with stones to the extent of 200lb. per square foot. The highest temperature registered was 120°. On Nov. 10 one of the silos was opened, and 15 tons of mangold and swede tops put in, and again sealed down as before. Fermentation rapidly set in, and the smell given off was most offensive.

On Jan. 5 the silos were opened. In No. 1, a piece 3ft. wide was cut right down, so that a complete section could be examined from top to bottom. About nine inches under the layer of straw was mouldy, and unfit for food, and nearly the same quantity at the sides. All the rest is excellent fodder and eagerly eaten by horses, cattle, and sheep.

No. 2 silo, in which the mangold tops were put, was then opened. This part of the experiment proved a complete failure, the tops being nothing more or less than a mass of corruption, and grubs innumerable, in various stages of development, swarmed amongst them. The ensilage under the mangold tops is in capital condition from top to bottom. It weighs 52½lb. per cubic foot.—*Agricultural Gazette.*

SILOS AT BLAENGAWR FARM, ABERDARE.

In the early part of July Messrs. D. Davis and Sons had two silos (measuring each 15ft. long, 14ft. high, 8ft. 6in. wide) filled with green meadow grass, covered with a layer of straw, then 1½in. planks, and weighted with ½cwt. iron weights one to a foot area. On Dec. 3 they opened one of them, and found about three inches of the layer of straw under the covering planks slightly mildewed. Under this it was free from mildew, with the exception of about an inch nearest the side wall, and the ensilage, on the whole, was of excellent quality.

MR. IMRIE'S SILO, WHITEHILL, LANARKSHIRE.

THE experiment at Whitehill was, we believe, the first that was made in Scotland, and Mr. Imrie invited the members of the Glasgow Agricultural Society to be present at the opening of his silo on Saturday, Feb. 7, 1883. Mr. Imrie had seen various references to ensilage, and being of an experimental turn of mind, thought he would try what he could do in a rough way. He had previously arranged to build a pit to hold draff for the use of the cattle during the winter months, and this he determined to utilise for a trial of the ensilage process. The silo is about 11ft. long, 9ft. broad, and 10ft. deep, and is partly under ground. It is built of brick and lime and pointed with cement, and at the bottom there is a drain with a sort of trap. On a rainy day at the end of September or beginning of October, 1882, Mr. Imrie cut down a quantity of fully half ripe vetches, corn, and beans, put them through the chaff cutter, and converted them into what is known as "mashlam." Dripping wet, he put the material into the pit, and tramped it all down firmly. As the "mashlam" was not sufficient to fill the silo, he placed on the top a layer of beans and corn, which were fully ripe, and had been dried and stacked before being put through the chaff-cutter. He also mixed about half a hundredweight of salt with the forage. After the mixture had undergone a thorough tramping, a covering of about two feet of clay was put on, and the silo closed. From some cause, the ensilage became depressed all round the side of the pit, leaving a slight cone in the centre.

When opened, on Feb. 17, 1883, the top layer, which was that of ripe corn and beans cut up by the chaff-cutter, had a strong sour odour, but after that was removed, and the layers of half ripe mashlam were reached, there was a perceptible diminution in the strength of the odour, and it was admitted that the ensilage was pretty fresh. Some of the farmers present thought the flavour was that of English hay, while others thought it was rather stronger, and more resembled draff. At one of the sides there were signs of heating, and it seemed as if, somehow or other, moisture had managed to find its way through the clay into the pit. Mr. Imrie explained that the material was placed in the pit in the worst possible condition. Unfortunately the servants had given the cows their midday meal, and it was a question whether any of them would look at it. A portion was placed before several cows, and though one or two did not seem to relish it, others ate it at once, and seemed to like it.

It was admitted that Mr. Imrie had placed insufficient weight on the silo, and the drain in the bottom of the pit was deemed to be an evil, as through it air may have reached the stored material. Another thing against the ensilage was that the vetches, beans, and corn were half ripe before being cut. Under the circumstances in which Mr. Imrie made his attempt, the result was considered very satisfactory.—*Glasgow Herald.*

SIR T. E. COLEBROOKE'S SILOS IN LANARKSHIRE.

In the Upper Ward of Lanarkshire Sir T. E. Colebroke, Bart., M.P., got two of his tenants to give the system a trial, on condition that he defrayed the cost of erecting the silos. On Nov. 24, 1883, the farm of Nether Abington, teuanted by Mr John Morton, was opened. The silo, built of stone and lime, is 15ft. long by 12ft. broad, the depth 12ft., and the thickness of wall 18in. The floor and sides were laid with cement. On Aug. 3 (this is a late high district) Mr Morton had 17 tons of meadow grass cut and deposited in the silo. The grass was pretty dry, and 1½lb. of salt per hundredweight was added. Wooden battens were placed on the top, and six tons of stones (about 70lb. per square foot). After three weeks these were removed, aud 4 tons of green oats, with 5 tons of rough pasture grass, were added to the mass, and the pressure was resumed as before. None of the stuff was chopped. Cost of the silo was 38*l*., exclusive of cartages, and the expense of filling was estimated at about 1*l*. per acre. After three months the ensilage was sampled. The rough grass was found to have kept admirably. A little overheating was appareut at the top of the oats, and the same at the juuction with timothy grass and the oats on the lower side of the latter. On the whole, however, the fodder had retained wonderfully green flavour. The experiment, taking everything into account, has been regarded as successful; but choppiug of the ranker fodder, and more pressure for such green stuff as the oats, were recommended, and will probahly be attended to in future.

The silo on Mr. Hunter's farm, of Kirkton, also erected by Sir T. E. Colebrooke, on much the same principle, is proving satisfactory.

MR. HAMILTON'S SILO, DALZELL, LANARKSHIRE.

At the home farm of Dalzell, Lanarkshire, the property of Mr. Hamilton, M.P., a silo has been erected and conducted by Mr. W. C. Bonallo, land steward. The silo is wholly above ground, 13ft. long, 13ft. deep, aud 10ft. broad, and cost only 22*l*. The walls are of 14in. brickwork, coated with cement, and the floor of concrete, and to facilitate emptying a boarded door is inserted at one corner, but was hermetically sealed outside by means of 4in. brickwork coated with cement. The silo was filled on the 16th July, and four following days, with grass grown in orchards and pleasure grounds. The grass was cut into chaff, and about 2lb. of salt was added for every cwt. The stuff was covered with doors, then by four inches of bran, and about 2 tons concrete blocks, affording pressure equal to 35lb. to the square foot. In the course of a fortnight the flooring and bran were removed, and more fodder deposited. The pressure was again applied for three months, after which the cows were fed daily, and seemed to relish the ensilage.

LORD BLANTYRE'S SILO, FREELANDS ERSKINE, RENFREWSHIRE.

ONE of the largest and most expensively built silos in Scotland was opened on Jan. 8, on the property of Lord Blantyre at Freelands Erskine, near Glasgow. The silo (an ordinary house in appearance) is built on a piece of level land, with the floor sunk 3ft. below the surface. It is 54ft. long, 20ft. 4in. wide, and has walls 12ft. high. The walls, 14in. thick, are built of sound red brick, pointed on the outside, and plastered inside with cement. The house is divided into four equal divisions by 14in. cross walls. The two end compartments are entered by two doors in each gable, the lower door being on a level with the surface, and the other, which is smaller, having its door sill on a level with the wall plate. The two centre divisions are not intended to be emptied until the end ones are cleared out, as doors enter through the division walls into the centre silos. The cost was as follows:—Digging, carting, and carriage, 32*l.* 4*s.* 6*d.*; ironwork, 62*l.* 16*s.* 2*d.*; stones, bricks, and cement, 140*l.* 12*s.* 8*d.*; slater and plumber work, 38*l.* 1*s.*—total, 273*l.* 14*s.* 9*d.* The work was done during June and July, and the building was barely finished when it was commenced to be filled.

On Aug. 23 about 25 tons of grass were put chaffed, into the first division. This grass was cut principally from under trees, or from land long pastured with sheep, the herbage of which they had not been eating, and had never been grass of other than a second-rate quality. Two-inch battens were placed on the top, and weights to the extent of 62lb. per square foot. On Sept. 7 boards and weights were removed, and 19 tons of oats, chopped into half-inch lengths, put in. These oats had grown principally under trees, and had been much lodged. The whole was again covered with battens—no intermediate material, such as bran or straw being used—and weighted with about 5 tons of old ferry chains and a few 56lb. weights, equal to about 62lb. per superficial foot.

On Aug. 31, 45 tons of chopped lodged oats were put in the second division; and between Sept. 24 and 28, 43 tons of beans and oats, chopped, were put into the fourth division, the third being left empty. During the filling of all the silos the weather was good.

On being opened, it was found that about 4 inches immediately under the planks were more or less decomposed and permeated with mould, and not of much, if any, use. The next foot in depth was free of evidences of decomposition or mould, but was quite dry, and had a musty smell, like overheated hay or manure; it, however, would be of some value for food, though not perfect in preservation. Below this layer (and each layer was very distinctly marked) the fodder was in a perfect state of preservation. The straw was moist, had a pleasant smell, and appeared to be relished by horses and cattle.—*North British Agriculturist.*

LORD SEAFIELD'S SILOS AT WOODSIDE AND TOCHINEAL.

THE opening of two silos on the farms of Woodside and Tochineal, near Cullen House, Banff, on Feb. 19, was the first occasion of the kind north of the Dee, and over 200 persons connected with farming, from the lord to the crofter, assembled to satisfy themselves as to the result of Lord Seafield's experiments.

The silo at Woodside, under the charge of Mr. Charles Urquhart, is of the simplest possible construction, made so intentionally that it might be adopted by the poorest class of tenants. It is simply an excavation in a dry bank close to the steading, a wall of which forms one side of the silo, the other three sides being the earth cut 6ft. down to the level of the floor of the steading, and with a slight slope to allow any water to run off. The top of the solid earth walls was made up three additional feet, making the entire height 9ft. This additional height was made by first facing it up with turf, as in building a turf dyke, and backing it behind with the excavations to a breadth of 4ft. or thereby. The size of the pit or silo was 16ft. by 16ft., and 9ft deep.

The silo was filled at three operations, viz., on Oct. 5 were deposited 26 tons of green oats off moss land, cut into an average length of 4in. with scythe blades. This crop had been sown a second time, the original crop having been destroyed by grub. Ten days after 12 tons were added, and at the expiry of eight days 10 tons more, making in all 48 tons. It was tramped down firm by several men as it was put in, covered over with inch boards, on which about two feet of sandy earth was laid and closely tramped and smoothed over with the back of the spade. Above the covering a taupaulin was laid upon a few rough poles, and some poles were also laid above it to keep it from blowing off with the wind. It was estimated that 26 tons of earth were put on, giving a pressure of about 2cwt. to the square foot. Four days after the first operation this pressure caused an average sinking of 5ft. Previous to the third operation the contents subsided 4ft. and became very hot. Total expense of making silo, 3*l.* 8*s.*; of preparing, filling, &c., 6*l.* 10*s.*

On opening the silo—that is, on removing a part of the earth covering —the extreme surface next the earth was dark and slightly rotten to a depth of about an inch; below this about six inches was quite white and mouldy; beyond this upper layer there was nothing mouldy or in any way injured down to the bottom. The upper part was comparatively dry, while the lower part was moist, and smelled more acid than the top. Some of the oats, which had been nearly ripe when put in, were as sound and sweet as if preserved in the dry state. The milch cows were fondest of the ensilage. The sheep also ate it freely. The horses did not relish it much, and the fat cattle refused it with few exceptions.

The silo at Tochineal, under the charge of Mr. Kemp, was formed in a disused building, and consisted of two compartments, each measuring

16ft. by 13½ft., and 15ft. high, a concrete wall 12in. thick separating the two. The interior is cemented. The silo has three doors and two skylights, and is erected against a bank of earth, the principal door, used for filling the silo, being on the bank side, 10ft. from the floor. The other two doors are on a level with the floor—one for each compartment—to be used for removing the ensilage. Only one compartment is in use this season. On Oct. 23, 20 tons 3cwt. 1qr. of ripe aftermath, slightly touched by frost, average length 9in., were stored in one operation, and covered over with a sprinkliug of straw; battens 13½ft. long and 2½in. thick were then laid on, and weighted with 18 tons of bricks, giving a pressure of about 190lb. to the square foot. The cost of building silo amounted to 80*l.*, and the expense of filling, &c., 3*l.* The ensilage was well preserved, and, except being a little mouldy on the top to a depth of 4in. or so, the stuff came out beautifully fresh. The silos are termed a thorough success.—*Farmers' Gazette.*

MR. G. YOUNG'S SILO, AT BLACKADDER, BERWICKSHIRE.

On Friday, Jan. 4, a large assemblage of landed proprietors, agriculturists, and others, took place on the farm of Blackadder West, the property of Sir Geo. Houstoun Boswall, Bart., and tenanted by Mr. Geo. Young, to inspect a silo and the ensilage therein contained. The silo measured 60ft. long by 10ft. wide and 10ft. deep. It was on sloping ground sunk 5ft. into the ground, the sides and ends being made of wooden planks 2½in. thick, 10ft. long, set on end and strengthened on the top by battens nailed round. A drain was brought up deep enough to remove any water from the bottom, and the bottom was lined with 2in. planks. When filled, 2in. planks were laid on the top, and it was weighted with stones to the extent of 170lb. per square foot, and thatched with straw for protection from the weather. The proprietor having given the timber, the cost to the tenant amounted only to about 15*l.*

On Aug. 23, four carts led tares from one reaper for half a day; on the 24th, eight carts led all day from two reapers, one on tares and the other on rye grass and clover, and it was then weighted. On the 27th, it having sunk about one-half, the silo was again filled, and also on the 31st, each time with a mixture of tares and grass; and lastly, on Sept. 13, it was filled with aftermath, and finally closed.

On opening the silo, the ensilage was very compact, 44lb. per cubic foot. There was hardly any mould, only about an inch on top and along the sides, and in some places not even so much. No salt was put into the silo, but in practice Mr. Young mixes the ensilage with chaff and a little meal, and puts a little salt into the mixture, which he allows to lie and ferment for twelve or twenty-four hours. The cattle are fed twice a day from this mash, receiving a foddering of turnips the first thing in the morning.

MR. MELROSE'S SILO, MONYNUT, BERWICKSHIRE.

Mr. Jonathan Melrose, President of the East Berwickshire Agricultural Society, last season converted a concrete water tank into a silo at Monynut, and had it filled at different times with about thirty tons of first and second cuttings of clover. The dimensions were 27ft. long, 7ft. broad, and 6ft. deep. It was weighted by means of cast-iron blocks, giving a pressure of about 160lb. per superficial foot. When opened, on the 20th of September, the silo emitted a strong aroma, and the ensilage was of a very dark brown hue. Cattle, however, ate it greedily, but horses only partially. It was generally considered by the practical men present at the opening that the experiment had been a success.

MR. DUDGEON'S SILO, WOODHOUSELESS, DUMFRIES.

The silo is built of stone and lime, and plastered with cement; the floor is also cemented, and the roof is of corrugated iron. It is 16ft. long, 12ft. wide, and 11ft. deep. The filling commenced on the 4th of August, and was resumed on four different occasions till the 22nd of September, when it was finally closed. The bulk of the stuff used was coarse rough pasture grass, with a few loads of clover and green oats on the top. The grass was mostly put in in a wet state. The weighting was by means of pig iron, and amounted to about 170lb. per square foot. A cubic foot of the ensilage was found to weigh 41½lb., and it was in grand order when opened, and it was eaten readily by cattle. There was no mouldiness on the top; the ensilage was good from top to bottom.

MR. RAMSAY'S SILO, CANTOSTANES, AYRSHIRE.

The silo is in a slope, fully 4ft. below the surface at the lowest end; the floor laid with lime, the walls of double bricks cemented, and roofed with wood and slate. The dimensions are 28ft. 6in. long, 14ft. 6in. wide, and 15ft. deep. Drains were put in round the sides of the silo. The cost was about 40*l.*, exclusive of cartage. The filling occupied about a fortnight; all the grass was put on before the weighting was applied, care being taken to trample the mass well as it was laid in. Meadow grass in a rather damp state was put in in the last week of July; and in the first week of August the produce of six acres of lea hay was deposited uncut, with some salt, and a weight of 80lb. to the square foot was applied. The silo was not touched from the first week of August till January, when the ensilage was found in good state, and cattle consumed it with an evident relish. The mass had sunk about 5ft., and there was a little liquid in the bottom.

MR. M'CONNEL'S SILOS, KNOCKDOLIAN, AYRSHIRE.

AT Knockdolian, Girvan, Mr. M'Connel has two silos, each 20ft. feet long, 10ft. wide, and 12ft. deep, built of masonry lined with cement, each covered with a low corrugated iron roof. The ensilage, which consisted of meadow and old grass, of growing corn, and vetch, was put into the silos in July and August, 1883. No. 1 silo was filled with chaffed ensilage. No. 2 with grass, &c., direct from the fields. Mr. M'Connel does not intend this year to chaff before siloing; it is troublesome and expensive; he has not experienced the difficulties which others seem to have done in chaffing ensilage, and the mixing of hay and straw with it is much more effectually done when they are all chaffed together. After filling the silo, a thin layer of straw was spread on the surface; on this were placed boards about 40in. long by 11in. wide and $1\frac{1}{2}$in. thick, laid about half an inch asunder, thus permitting the escape of air through the intervening spaces; and for weighting, three pieces of pig iron 56lb. each were placed on each board, Mr. M'Connel's object being to have equal pressure over the whole surface. He found, however, that the ensilage in the middle of the silo sank much more than at the sides, so he moved some of the weight from the middle to the sides. With No. 2 silo, in which the ensilage was not chaffed, he increased the surface weight by about 20lb. per foot, and this extra pressure may have been one cause why the unchaffed ensilage was more appreciated than that which was chaffed. Mr. M'Connel is intending this season to increase the surface weight to about 75lb. in the centre of the silo, and about 100lb. at the walls; not so much to improve the quality of the ensilage, for the cattle ate it with avidity, though the vetch and the oaten hay was slightly inclined to acidity, but the weight per cubic foot did not exceed 43lb., and by having heavier surface weights the silo would hold more.

A great deal has been said about the inconvenience of moving the weights whilst in the process of filling, and some ingenious plans have been proposed to use machinery for the purpose, which no doubt would save some trouble; but machinery costs money, and no tenant in the Scotch system of nineteen years leases, and much less no yearly tenant, would like to go to any expense not absolutely necessary which would outlive his tenancy: and Mr. M'Connel gives as his experience that the cost of putting on the weights and boards and moving them again, say three times, did not exceed 4*d*. per ton of ensilage. Mr. M'Connel found the iron weights and small boards very handy to deal with whilst cutting out the ensilage, as one, two, or three boards could be removed just as wanted, without disturbing the rest of the silo. His silos were built into a hill, the ensilage was put in from carts at the top and taken out at the bottom, through a doorway level with the road—the door being bricked up before the silo was filled, the bricks being removed when the fodder was wanted. The walls were covered with flat tiles, so that the roof, by the help of small rollers which were let into the frame wood-work of the roof, could be easily moved endways, whilst the silo was being filled.

SILO ON THE MARQUIS OF BUTE'S HOME FARM.

A SILO on the Marquis of Bute's home farm in Bute had been constructed and carried on under the eye of his lordship's factor, Mr. J. Windsor Stuart. It was formed in a part barn, and the dimensions were 18ft. long, 6ft. wide, and 8ft. deep. The partitioning was of brick, 14in. thick. The floor and walls were carefully cemented, and the cost was only 10*l.* 16*s.* On July 18 and 19, about twenty-one tons of grass, fully one-half natural and the rest clover were deposited, and bricks to the weight of 57lb. to the superficial foot were applied. To each cwt. of grass, $1\frac{1}{2}$lb. of common salt was allowed. On Aug. 10 the silo was opened, and the mass had sunk 2ft. Four tons more grass was put in, and the silo closed. Bran was placed over the ensilage, but Mr. Stuart does not consider this necessary, and does not mean to repeat the bran covering. The grass was chopped. When the silo was opened, about three inches on the top was in bad order, a sort of cake, but the rest of it was in grand condition, and horses and cattle ate it readily. It is intended next year to apply greater weight.

Ensilage from this silo was supplied to three farmers in the Island of Bute—Messrs. Hugh Duncan, of Longalcorad; Hugh M'Lean, of Ascog; and John Martin, of Ardnahoe—who conducted experiments in the feeding of dairy cows. A week's food was taken away at a time. Messrs. Martin and Duncan had no difficulty in keeping it sweet throughout that time, but Mr. M'Lean had. The cows seemed to relish it, and improved in condition under it; while the milk and butter at the same time improved in quantity and quality.

Mr. Duncan had two cows that calved in July and August, fed for fourteen days on 56lb. hay and chaff, 75lb. turnips, 8lb. oilcake, 9lb. bean-meal. The average daily yield of milk was two and a half imperial gallons; butter from milk of last seven days, 6lb. The next fourteen days Mr. Duncan gave his cows 14lb. hay, 40lb. ensilage, 6lb. oilcake, and 8lb. bean meal. The daily yield of milk was three gallons, and the butter from last seven days' milk, 7lb.; being an increase of half a gallon of milk per day, and a pound of butter per week.

Mr. Martin had two cows that calved in April last fattened for a fortnight on 10lb. hay, 75lb. turnips, 6lb. oilcake, and 6lb. of bean meal daily. Their milk produced 4lb. of butter the first week, and the second $4\frac{1}{4}$lb. Instead of the hay he gave 24lb. ensilage the next fortnight, with the result that the butter increased to $4\frac{1}{2}$lb. the first week, and 5lb. the second. The increase of milk per cow on the ensilage was three imperial pints.

Mr. McLean's two cows had calved on the 21st and 28th of November. Having calved more recently, their flow of milk, of course, was heavier. For fourteen days they got 34lb. hay, 160lb. turnips, and 12lb. beanmeal; and the average yield of milk was five and a half gallons per day. The next fortnight the hay was dropped, and 90lb. ensilage, 66lb. turnips, and 12lb. beanmeal were given. The first week of this fortnight was signalised by an increase in the milk; but it fell off a little the last week, through the ensilage not keeping perfectly.

MR. LANG'S SILO AT ANNETHILL, NEW MONKLAND.

A SILO made at New Monkland, in the West of Scotland, by Mr. Wm. Lang, farmer, Annethill, consisted of a hole dug near the steading, with side walls built roughly of stone, and no roofing. On Oct. 23 the pit was filled with 25 tons of clover and tares, and about the average pressure applied. It was not disturbed till the end of February, when it was opened and a small cut was taken out. Though the odour was strong, cattle ate the ensilage readily; but it was found to be more palatable after it had lain a day. The quantity and quality of both butter and milk increased when the cows were fed with ensilage.

WAVERLEY HYDROPATHIC ESTABLISHMENT.

ON the grounds attached to the Waverley Hydropathic Establishment a silo was formed out of a disused gas tank. It was 21ft. in diameter, with concrete walls 18in. thick, the floor being of the same material, 7½ft. below the surface of the ground. Into this tank about 11 tons of grass was placed during the second week of August, each load being carefully trodden down. A closely fitting cover was made, cut into four segments. This was weighted with iron and stones to the extent of 100lb. to the square foot, in addition to which two beams were bolted down to the top of the walls, from which a long iron screw was fitted in connection with a weight placed in the centre of each segment. These, by being turned daily, materially assisted in driving out the air and the compression of the mass. When opened, on Jan. 24, not a particle of mould was found at the top; and the quality of the ensilage and the manner in which it has turned out were deemed by those present to be a complete success.—*Hawick Express.*

MR. OLIVER'S SILO, HOUPASLEY, HAWICK.

AT a recent meeting of the Teviotdale Farmers' Club at Hawick, Mr. Oliver, of Houpasley, described his experience. His silo was built under ground about 6ft. square, with side walls formed roughly of brick 4½in. thick. It was filled with natural grass at three different stages in August, and for the first month the weighting applied was about 2cwt. per square foot. Latterly only about one-third of that weight was brought to bear. When opened, no mould was discovered on the top, but the sides had done badly, presumably owing to the roughness and openness of the walls. At first all stock fought shy of the ensilage. Latterly, however, dairy cows consumed it, and the result was a visible increase in the yield of milk and weight of butter. Since the silo has been opened, the decay and fermentation at the sides have increased and spread over the top. It cannot, therefore, be said that the Houpasley silo of 1883 has been a success; but its comparative failure is understood to be due to defective treatment which experience can avoid.

MR. MACKENZIE'S SILOS, PORTMORE, PEEBLESSHIRE.

THE most important of the experiments hitherto carried out north of the Tweed have been those conducted by Mr. Mackenzie, of Portmore, Peeblesshire, under the auspices of the Highland and Agricultural Society. Mr. Mackenzie, who has for several years been one of the most serviceable and popular directors of this society, visited America in 1882, and was so much convinced of the value of ensilage that he laid the matter before the directorate. There was a difficulty in the society's way, in that there was no farm at its command on which to make experiments. Mr. Mackenzie accordingly offered to carry them out on his own farms, and to bear the expense, it being understood that they should have all the *éclat* that a connection with the Highland and Agricultural Society could give them, and that the society's popular chemist, Dr. Aitken, should render his advice and, in the matter of subsequent analysis, services. The society readily accepted this generous offer, and arrangements were made for the erection of two silos—one at Harcus Farm, and the other at Early Pier Farm.

The Harcus silo was constructed between May 15 and June 16. The ground sloped, but not so much as to enable the base at either end to be level with the surface; it was 5ft. below. The dimensions were 30ft. long, 12ft. wide, and 13ft. deep; the walls at the bank end and at the sides, which were supported to some extent by the excavations, were 12in. thick; at the exposed end the wall was 15in.; both walls and floor were of concrete, consisting of seven parts of gravel and sand to one part of best Portland cement; eleven pillars 5ft. high, 1ft. square, and 5ft. apart support the roof, which is of home-grown fir, with a covering of roofing felt, projecting sufficiently to throw off the rain water. The door for taking out the ensilage is level with the ground at the more exposed end. The cost, including excavations, building, cement, roofing, and cartage, was 79*l*. The cost of planking and of weighting apparatus (which consisted of square boxes, filled with shingle) amounted to 12*l*. 10*s*.

Filling commenced on July 30, and by Aug. 8 there had been deposited 6 tons of clover and rye grass, 4½ tons of coarse plantation grass, 7½ tons of oats after green crop sown out, 3 tons rough plantation grass, 19 tons oats after lea, and 4 tons of plantation grass—in all 44 tons. By Aug. 16 the mass had subsided 5½ft. under a pressure of about 60lb. per superficial foot. Thereafter the silo was uncovered, and 24 tons of oats with peas, grown together, were put in, and the pressure was increased to about 150lb. per square foot. By Sept. 5 the bulk was reduced by about 4½ft., when the heap was uncovered, and 6 tons of plantation grass, with 3 tons of oats and peas, were added. The silo was closed on Sept. 11, and sunk 3½ft. more before it was opened in December.

From the first filling till well through autumn a heating test was carried on by the introduction of an iron rod nearly 9ft. long. Little more than the mere chill was off the rod, however, at any period.

When the silo was opened on Dec. 8, about six inches in front of the door and some three inches on the top were mouldy; otherwise the ensilage was found in good order. There was no chance of escape for the liquid pressed out of the green forage, the floor having been laid with concrete; and on the 20th, when the public inspection took place, there was about two inches of liquid in the bottom of the silo, which it is proposed to utilise as feeding material by mixing it with bran. The odour was very powerful, the silo having then been open for nearly a fortnight and some tons removed. The ensilage seemed very dark in colour, especially the oats portion, but cattle, as well as horses, ate it readily. The old grass seemed to have produced the best ensilage. The oats, it was thought by some, might have been better if chopped before being deposited; and the ensilage had so decayed an appearance that the company were not captivated by it; but they could not forget that stock consumed it, and were willing to await the feeding tests and analysis.

The silo at Early Pier Farm was constructed similarly to the one just described. It was, however, in a deeper slope, with the result that the base and door on the one end were on a level with the surface. The dimensions were 24ft. 3in. long, 12ft. wide, and 15½ft. deep, and the cost 87*l.* 4*s.* 7*d.* The pressure was applied in the same way as before. The silo was filled on Aug. 8, 9, and 10, in wet weather, with 42 tons of a heavy crop of clover and rye grass, the stuff being quite saturated. It sank about seven feet by Aug. 25, when 28 tons, cut off an old grass field, were lodged in the silo. The 150lb. per superficial foot pressure was then applied, and the silo closed. A little liquid oozed out at the door, but the odour was not so strong as at Harcus. When the silo was opened on Dec. 20 about three inches on the surface were not so good as could have been desired. Below that, however, the old grass seemed to have been very finely preserved. It cut up beautifully, and cattle ate it readily; it was delicious in flavour. The clover and rye grass below was not reached.

The general impression which the "demonstration" left on the minds of the visitors was, that so far it had been a success; that old grass in plantations or mansion house grounds was best adapted for the silo; that ranker forage, such as green or partially ripened oats, should be chopped; and that the system requires a little further elucidation and test before a silo can be looked for at every farm. At the same time all admitted that the success of this system, notably on landowners' home farms, or on hill grazings occupied by tenants, where there is plenty of rough grass, was, as far as a year's work could do it, established.

It should be explained that the Portmore silos, with the view of demonstrating the system as favourably as possible, have been constructed on an expensive scale, possibly about one-third beyond what is really necessary. The buildings are ornaments as well as subjects of utility.

About three months after the Portmore silos were opened it was stated that they were turning out beyond the anticipations formed at and shortly after the opening, and that both cattle and sheep were doing well.

SILO AT YOUNG'S PARAFFIN WORKS.

Mr. M'Morran, farm manager to Young's Paraffin Light Company, opened a silo at the company's Burngrange Farm on Feb. 14. The silo is 20ft. long, 8ft. wide, by 7ft. deep. The side walls and one end wall are brick, 14in. thick, the inner course laid in a mortar composed of lime and Portland cement; the front end is tightly closed by 3in. planks, fitting edge to edge, and secured to the side walls by strong bolts, screwed on the outside to upright wooden bars, which reach from the bottom to the top of each wall. The floor, which was raised about 6in. in the centre, sloped gradually to the sides, and was covered with coarse engine ashes. A drain, about 6in. below the floor, passes round the building about 6in. from the wall, the openings being led into a field drain. The silo is mostly below the surface, the portion of the walls above being backed up with the clay dug out, and not more than about 2ft. being bare. The whole is covered in by a wooden roof.

The crop operated upon was principally a mixed one—corn and vetches—with a layer of soft grass from an irrigated field. The silo was filled, in the first week in September. to a height of about 2ft. above the top of the wall. In about ten days the weights were taken off, and it was again filled up to about the same height over the walls, when it was finally loaded. The top was covered by a platform of 3in. planks, laid closely together and secured by two strong transverse bars. On this platform cast iron plates, uniform in size and thickness, were laid to about 1½cwt. to the superficial foot. The platform had 1in. of space between the end of the planks and walls.

The crop was left uncut until it had attained its full growth, by which time the corn stalks were considerably hardened, and a large number of the vetch pods quite filled and ripened. This made proper compression more difficult, and showed that it would be better to cut earlier, as, even under the great weight applied, the corn stalks remained hollow, owing to the strength of the fibres. The layer of soft grass was quite firm, and almost as green as when it was put in. Whether owing to a want of compression at the sides (for, the floor being highest in the centre, the planks could not settle evenly), or to the rigid nature of the crop, or perhaps a little to both, a great amount of waste occurred, fully a foot near the wall being rotted. Mr. M'Morran calculated the weight put in at 13 tons. When opened, the compressed food measured 4½ft. deep; a cubic foot, taken 18in. from the top and from the side, weighed 50lb.

A lot of young cattle in an adjoining shed had some of the ensilage given them, and, although it was the afternoon and they had got their usual allowance of oilcake and roots, they ate it freely. Next morning, after being fed in the same way, the ensilage was again given; and, although their racks were full of dry fodder, they cleaned out their trough after a second supply. The young horses at the farm are also eating ensilage freely. Six two-year-olds, shut in for stall-feeding at Burngrange, broke from their yard on the second morning after the

opening of the silo, and, to Mr. M'Morran's surprise, he found them eating greedily a quantity of the ensilage that he had thrown aside as refuse, having been dressed off from the front and sides of the heap. To Young's Company, who farm a large tract of land and keep large herds of cattle, the silo will be of great advantage, as immense quantities of good green stuff will thereby be saved for winter use which otherwise would rot in the fields.

The cost of erection, not including cartage of material, was 26*l.* 15*s.*, being about $5\frac{1}{2}$*d.* per cubic foot of space.

MR. RENNIE'S SILO AT ALLANFAULD, STIRLINGSHIRE.

Mr. Jas. Rennie, of Allanfauld Farm, Kilsyth, Stirlingshire, on the property of Sir William Edmonston, Bart., opened at the beginning of January a silo on his farm, which possesses peculiar interest, in so far as the fodder was solely of the hill-grazing order. The silo is 32ft. long, 9ft. deep, and 9ft. wide, and is 5ft. below the ground. An 18in. drain was below the walls, to keep away damp. The walls are 2ft. thick, built of common stone and lime, well pointed. The bottom is laid with engine ashes, and then covered with wood pitched with tar. The cost, including the boards for covering, was 30*l.*

On the 24th of August fifty cartloads of rough grass and sproats, cut that day, were put into the silo in a rather damp state. On the 18th of September thirty loads were put in, also a little wet. The fodder was well shaken and trampled when put in, and was weighted with 12 tons of stone (about 90lb. to the square foot). When opened the silo showed indifferently along by the side of the walls. The fodder was somewhat spoiled there, which was attributed to the rough state of the walls having allowed of the admission of air. The walls should have been cemented: and Mr. Rennie means to have this done by next year. The main body of the mass, however, was very sweet, and in capital order. Samples of the ensilage were given to cattle, and they partook of it with an evident relish. The success of Mr. Rennie's experiment tends to confirm the belief that rough hill grass can be advantageously converted into ensilage. In that case the silo cannot fail to be a great boon to hill or stock farmers, who are often in such straits in winter and spring for food for stock.

MR. MONTEITH'S SILO AT CARSTAIRS.

An experimental silo, constructed for Mr. J. Monteith, of Carstairs House, was opened on Nov. 29, 1883. It was filled and closed on Aug 1, about eleven tons being put in and a pressure of 250lb. to the square foot applied. Rye and timothy were placed in the lower part of the silo, and on the top was plantation grass, cut from among trees and put in very wet. When opened the ensilage came out in good condition; both horses and cattle took to it readily, and the sheep seemed exceedingly fond of it.

MR. DUNCAN'S SILOS, BENMORE AND BLAIRMORE.

There is probably no more energetic landed proprietor in the West of Scotland than Mr. Duncan, of Benmore and Blairmore. He has planted trees extensively and reclaimed a great deal of land, and he owns a valuable herd of Highland cattle, as well as a select stock of black-faced sheep. Mr. Duncan gave instructions to his manager, Mr. Wood, to erect a large silo at the home farm of Blairmore, and another at the home farm of Benmore. The work was accomplished last spring, and both silos were pretty nearly filled in autumn with natural grasses and green oats.

The Blairmore silo is divided into sections of 20ft. square, with a similar depth. The side walls are of concrete, 11in. thick, and the dividing walls of the same material, but only 7in. thick. The roof is of wood, coated with tar. Fifteen feet are below the ground, on a slope, and the roof is 5ft. above the walls. The cost of the silo was 160*l.*, of which 53*l.* 13*s.* 6*d.* were for labour, and 71*l.* 13*s.* 10*d.* for materials. There was not grass and oats enough to fill it; but 280 tons were put in—grass and corn as they grow carted direct to the pit in both wet and dry weather. Weighting was applied, about ten tons of boulder stones affording a pressure of 56lb. to the square foot. When the silo was opened the ensilage was found in good order, and stock are fond of it. A cubic yard weighed 12cwt. About 120 cattle were fed on ensilage. Ayrshire cows got daily 45lb. corn ensilage, 34lb. turnips, 5lb. of draff, and 6lb. of straw or chaff. Those not giving milk were getting too fat on this fare, and the ensilage had to be reduced.

The Benmore silo is similar to the other, except that it is only 16ft. deep, of which 9ft. are below the surface. No liquid has been observed in the bottom of the pits.

The following is a copy of the analysis of a sample of meadow grass ensilage from Benmore, made by Mr. John Newlands, F.I.C., F.C.S., 9, Mincing-lane, London:

	Per cwt.
Water	78·42
Albuminous matter*	2·22
Sugar, gum, and extractive matter, soluble in water	2·36
Oil, wax, chlorophyll, &c.	1·11
Digestive fibre	7·95
Indigestible woody fibre	6·14
Mineral matter	1·81
	100·00

* Containing nitrogen, 0·35; equal to ammonia, 0·42.

After the dairy cows had been fed on meadow hay ensilage for three or four months, it was stated that the animals maintained condition, gave milk heavily, and that both milk and butter were delicious, being quite as palatable as when the cows were grass fed. Sheep also fed on the ensilage with an evident relish, preferring it to good sound hay. Mr. Wood, manager at Blairmore, believes that more attention is necessary to protect the sides of the silos from moulding or decay.

ENSILAGE OF TURNIP TOPS AT CULDUTHAL.

[Mr. W. Brougham, of Culduthal House, near Inverness, gave in the *Field* a lengthy account of his experiments in 1882 and 1883, from which the following particulars are extracted.]

I ordered all the turnip tops as they were cut from the roots to be carefully and cleanly put in heaps, and then to be carted to the silo which I set about constructing. At a convenient distance from the steading a pit was dug, 10ft. deep and 14ft. by 15ft. wide. But this was a matter of no little difficulty, as the sand was so sharp and dry that it was necessary to prop up the sides strongly while the excavation was going on. When this was accomplished, the sand and gravel were found to be the very thing wanted to mix with Portland cement, and a wall 12in. thick was run up, and a roof of corrugated iron put on. Sandy gravel formed the bottom of the pit, on which was placed rough boards; above this a few inches of straw. Two feet of turnip tops were then placed in the silo, when three men with sharp spades quickly did the work of the proper ensilage knife, while the tramping reduced the tops to an equal surface. This was now freely sprinkled with salt, and then a 6in. layer of straw spread evenly over the surface, on which 2ft. of the turnip tops were again placed and sliced as before, and the process continued until the pit was full. This was completed on Nov. 22, 1882. It was estimated that twelve tons of turnip tops were introduced into the pit, and that probably there was a loss of two tons by the juices passing into the gravel. This is, however, quite conjectural. The surface was covered with good strong boards, over which 2ft. of clay from a pond was placed. In addition, the turnip crop was placed as far as possible within the building, where the roots, covered with straw, were preserved in most beautiful condition to the end of the season. When the hungry beasts were feeling the greatest want of green meat, the silo was opened. To the great satisfaction of all concerned, the experiment was found to be a perfect success. Cattle and pigs ate of it greedily, so that from April 10 to May 12 we were amply provided with succulent food. The cattle would always leave their nice spring grass and turn to the turnip ensilage, even when the herb was ankle deep.

After the success with the turnip tops, Mr. Johnston and the writer had a severe attack of "Ensilage on the brain" and the result showed itself in the construction of two other silos, somewhat larger than the first; and being prepared fully for the work to be done before commencing the campaign, there was no difficulty in fixing the sandy soil. In fact though only a few feet removed from the first silo, the second did not give nearly as much trouble, so we were quite ready with our pits when required. But other things were necessary as well as pits, and one of the first was a proper engine and cutter. I therefore looked about for a nice handy

engine, and selected a Buckett's Caloric, 12 h.-p.; and, after considerable delay, it was erected. In the meantime the clover and seeds were losing ground, and we had to begin haymaking, and a proper undertaking it was. I think I never experienced a more vexatious season. At last we got the engine to work, and a glance was sufficient to prove success was sure. Three good mowers, three carts, three men at the pit, with women and children, were kept in steady and constant work. Oh, such a relief to the hay-making process to which we had been subjected. And thus we walked through 60 tons, as one may say, right off. The mowers worked for five hours, and then ensilaged the cut in the afternoon, so secure did everyone feel, and so independent of the weather. Then as to comparative expense. That of converting grass into ensilage is estimated to be 1*s*. per ton, exclusive of interest on capital required for machinery and buildings. To turn the same quantity of grass into hay, 3*s*. is the usual cost in a good season; but what in a bad?

On the 20th of October, No. 1 ensilage pit was opened. It was then evident that the clay (the weight used was 166lb. to the superficial foot) had not pressed equally on the grass. At the edges there was a margin of musty or mouldy grass, caused seemingly by want of equal pressure. The settlement of the clay had caused it to act as a wedge in the silo, so that it formed a roof over the ensilage, rather than acting as a dead weight. From not foreseeing this natural action of the clay, a small portion of the grass was consequently lost; but this being removed, the whole was as good as it could possibly be. All the cattle ate it greedily; and the milk improved just one degree in value (by lactometer) very shortly after it was given to the cows.

With this I forward three specimens of No. 1 pit, as taken from the top, middle, and bottom of the silo. You will at once see there is a considerable difference. The top weighs 28lb. to the cubic foot, the centre 30¼lb., the bottom 34lb.; there is therefore a difference of 6lb.

As far as inspection leads one to a conclusion, I am quite unable to perceive that there is any filtering of fluid from the mass. We endeavour to keep the cut surface as free from exposure as possible. I notice the grieve is very careful in this respect, and he is quite right, for clearly an active fermentation is going on, as evidenced by a stronger vinous odour, even more distinct than when the pit was opened.

[The three samples sent were all of chopped grass and clover, varying from one to two inches in length; the whole of them were good, but we preferred the lowest and heaviest. Considering their light weight, their condition was remarkable, as they were by no means so compact as the majority of good samples we have met with; and we conclude that the herbage was rather dry when pitted. That a portion was spoilt, is in accordance with previous experience, when clay has been used as a covering. M. Goffart relates that when he used clay as a covering he invariably found a space between the clay and the ensilage, and that deterioration had resulted.—Ed.]

SIR D. BAIRD'S SILO AT NEWBYTH, EAST LOTHIAN.

THE silo was constructed out of the remains of an old brick-kiln, and measured about 12ft. by 12ft., with a depth of about 9ft. On Oct. 1 some 16 tons of lawn grass, cut wet, was put into the silo, each layer receiving a slight sprinkling of salt, the whole covered with inch boards, and over all a coating of sawdust 2in. thick. The weights used were common rubble stones put into small bags. On opening the silo at the end of January the grass, although highly coloured, smelt quite fresh, there being neither mould nor waste of any kind.—*Agricultural Gazette.*

SILO AT CRAIG PARK, MIDLOTHIAN.

ON the property of Mr. Firman, at Craigpark, Ratho, Midlothian, a silo, 10ft. long, 10ft. wide, and 10ft. deep, was opened at the beginning of February. The walls and bottoms are of concrete (one part of cement to four of sand, and four of clean gravel with loose stones buried in it), and the roof of corrugated iron. It cost 36*l.* Filling took place in the second week of October, and eight acres second growth of clover and rye grass hay was put in fresh. It was well trampled by horses, and, with planking and stones, a pressure of about 130lb. to the square foot was applied. A few inches at the top when opened was inferior, but the great bulk was in first-class trim. Cattle ate it greedily and so did pigs. Horses also partook of it, but not so readily. The cost of filling and carting was estimated at 2*l.* The contents of the silo of really good food are about ten tons. The experiment is considered a success, and, indeed, as representing a clear gain, seeing that the weather was very unfavourable last autumn, and the aftermath could not otherwise have been saved in good condition.

SILOS AT FINLAYSTONE, PORT-GLASGOW.

MR. ALEX. SMITH, Burnside, Finlaystone, Port-Glasgow, opened in February, a silo erected for him by his landlord, Col. D. C. R. C. Buchanan, of Drumpellier. The silo (which is capable of containing about thirty tons, with arrangements for enlargement if successful) is built to the back of the stable, and inclosed by a concrete wall, about 11ft. high, all under the roof of the court. It was filled at two different times with ryegrass and clover, and on the top with grass cut from plantations. When opened, there was noticeable a slight tendency to waste round the upper edges at the ends of the cross boards, which were cut an inch short to allow them to fall down easily with the pressure of stones above; but, with this exception, the ensilage came out quite fresh, and cattle, horses, and pigs, ate it with great relish. Mr. Smith intends to enlarge the silo, and is perfectly sure that by next season he will be able to preserve a large quantity of green food. Col. Buchanan has also erected a silo on the farm of Auchinbothie, which will be filled next season.—*The Farmer.*

MR. STIRLING'S SILO, KIPPENDAVIE, PERTHSHIRE.

On the home farm of Kippendavie, Perthshire, the proprietor, Mr. Stirling, erected a silo 12ft. long by the same width and 10½ft. deep. The walls were built of 9in. bricks and ¾in. cement, and the floor was laid with concrete. Some 16 tons were put in on Aug. 21 and 22, consisting of twenty cartloads of coarse grass, cut in the plantations, one load of good second-cutting of clover, and four loads of green oats—four cartloads of grass alternating with one of the oats. About ½lb. of salt was applied to each cut of grass. The mass was then trodden and pressed, and was not touched till Nov. 30, when the silo was opened. The top and sides were in bad condition; the rest, however, was in splendid order, and cattle as well as horses ate it readily. The cost of the filling and the material was estimated at about 20*l.* So well pleased is Mr Stirling with the experiment, that he intends next year to erect a silo capable of containing 100 tons.

DR. BARKIE'S SILO, TANKERNESS, ORKNEY.

An ensilage experiment has been conducted by Mr. Johnston, factor to Dr. Barkie of Tankerness. The silo is wholly above ground, and consists of a portion of a large hall at the home farm, measuring 17ft. in length, 11ft. in width, and 13ft. in height. The floor was laid with flags pointed with cement, and the side walls, two-thirds up, were plastered with cement. At one end there was only a wooden partition, 1½in. thick, battened and cemented. On the 18th of July the silo was about two-thirds filled with sown grasses. Boards were laid on the top, with a blending of soil and about 2ft. deep of stone. The mass sunk from 9ft. to 4½ft., which it was when opened the other day. About 2in. on the surface was mouldy and decayed-looking, and so was a considerable portion next the wooden end, which had not been sufficient to keep out the air. The rest of the ensilage, however, was good, and is being freely partaken of by cattle daily.

MR. HENDERSON'S SILO, ROSEBANK, WICK.

Last summer, Mr Henderson had a small silo made, the bottom and sides being lined with stone and cemented, and a wooden roof covered with felt. It was filled with rough pasture grass about the middle of July, and weighted to about 100lb. per square foot. In two months it had subsided about one-third of the depth, when it was refilled with the same kind of grass. On being open in January, the grass last put in was very dark in colour, and had a very disagreeable strong smell; but on getting down to the grass first put in, it seemed to be quite sound, and the cattle ate it freely. At the bottom of the silo there was such a quantity of liquid that it required to be frequently baled out.

MR. E. J. SMITH'S SILO AT CLONARD, DUNDRUM, CO. DUBLIN.

MR. SMITH has had an old building formerly used as a coach house and stable turned into a silo, the dividing wall being removed and doors and windows shut up. The silo is 24ft. long, 12ft. wide, and 13ft. 8in. deep. The floor was sunk about 2ft., then laid with 9 inches of concrete and flushed with cement. The old walls were scraped and lined with concrete and cement, to make them perfectly smooth and air-tight. At one end a new 18in. wall was built of concrete, and at the other end the old coach-house door was built up in a similar way. The corners were rounded off with concrete to insure close packing. In the new concrete wall a door was made, but it was temporarily built up with bricks (lined inside with cement), so as to be picked out and the doorway opened when the silo is emptied. For filling the silo, an opening nearly 5ft. square was formed at the top of the old end wall, about 14ft. from the ground. To lessen the difficulty in pitching the fodder through so high an opening, an embankment has been formed outside. Upon this embankment the loads of fodder are turned over, and it is easy for a man to throw the fodder into the silo with the ordinary fork.

The filling of the silo commenced on the 11th, and was finished on the 18th of July. The only material put in was the produce of $4\frac{3}{4}$ Irish acres of old meadow grass, taken to the silo just as it was cut, and most of it was too ripe to make good fodder. On July 11 fourteen loads were put in, work being stopped early in the afternoon by an excessive fall of rain. On the next day, which was also showery, twenty-one loads were put in; while on July 13, which was exceedingly wet, twenty-four loads were carried. On the third day the rain at times fell in torrents, but Mr. Smith decided to persist with the filling operations. The grass was so wet that when lifted on the fork the water ran out of it.

While the grass was being put into the silo, one man was constantly employed spreading the material evenly, and one boy and four or five women were kept tramping. By the evening of the 13th about 30 tons were put in, filling the silo to a depth of 11ft.; the grass was then covered with planks and weighted with about 9 tons of stones. On the 18th the silo was opened, and 15 tons of grass were added, the grass being now about a foot above the walls of the silo. The planks were replaced and weighted with 27 tons of stone, or about 210lb. to the square foot. For this purpose large stones were used, of which there was an abundant supply close at hand. In a small loft in a building attached to the silo provision was made for holding the stones, and the arrangements devised to assist in moving the stones from the loft to the silo and from the silo to the loft are exceedingly simple and efficient. A line of light rails resting on medium planks has been erected along above the silo and loft, being, for the sake of strength, attached both to the

cross-bars of the rafters and to the top of the roof. On these rails there is placed a small square block with four wheels, so made that they cannot slip off the rail. To this block, by a bolt passing through the centre, a "differential" pulley is fixed. The chains of the pulley are put round the large stones, and in this way granite blocks weighing more than 4cwt. are moved with the greatest ease from the one end of the silo to the other and on to the storing loft. For the smaller stones a board is hung from the pulley. When the silo was opened on the morning of the 18th twenty-five tons of stones lying on the planks were removed in three hours by six men and two boys.

The whole of the work connected with the forming of the silo and putting up the 27 tons of stones for weighting, as well as the outside embankment, was let by contract, and the entire cost was rather less than 50*l*. The concrete work was made, perhaps, rather more substantial than was really necessary, the quantity of cement used being 3 tons 14 cwt. The roof of the building was strengthened, and skylights were put in. The silo contained 45 tons of fodder, but from 20 to 30 tons more might be stored in it.

When the silo was opened, on Dec. 27, the results were exceedingly satisfactory. The fodder was found in excellent condition, and samples of it were eaten readily by cattle. A number of agriculturists witnessed the opening of the silo, and with the appearance of the ensilage they were agreeably surprised. In the company there were sceptics, and yet they had little fault to find. When the stones and boards were removed the smell was barely perceptible. On the surface a layer, 2 or 3in. in thickness, was black and mouldy—almost unfit for consumption. Beneath this the grass came out in admirable condition, in colour not unlike grass withered by exposure, and with a faint yellowish tinge. Six inches below the surface the mass was found to be warm, and it gave off a heavy smell, not quite so keenly alcoholic as we had expected. Neither the smell nor the flavour were discouraging, and the acidity of the latter was not strong, but decided. Mr. Smith is to be congratulated on the success of his experiment.—*Irish Farmers' Gazette.*

EXPERIMENT AT BESSBROOK.

The silo constructed by the Bessbrook Spinning Company at Bessbrook, in July last, and filled with 20 tons of newly-mown grass, was opened on Dec. 14. The ensilage was found to be in a good state of preservation, though that taken from the top of the silo was not quite as good as that from the middle or bottom. A quantity of the ensilage was given to a dozen cows which had never previously tasted such food, and it was at once eaten with apparent relish. A number of gentlemen farmers near the neighbourhood contemplate erecting permanent silos during the ensuing year.—*Irish Farmers' Gazette.*

SIR J. C. KENNEDY'S SILO AT JOHNSTOWN KENNEDY, CO. DUBLIN.

Sir J. C. Kennedy's steward gave the following particulars :—" On one side of Sir J. Kennedy's farmyard there is an excavation under the same roof with one of the cowsheds, and known as 'the turnip hole.' It is about 20ft. long, 10ft. wide, and 10ft. deep. The walls are rough and unplastered. Into this the produce of a couple of acres of coarse grass, grown under trees, and which usually went to loss, was thrown. After being well packed in, blocks of timber, cut in lengths suitable for paling-posts, and for which a place of storage was required, were placed in sufficient quantity to insure ample weight. There were no boards used for the top, no sealing up of the place of storage—no trouble whatever taken, in fact. In due time the silo was opened, and the ensilage is such that the cattle eat greedily and thrive well on what otherwise would have been a lot of useless stuff, except as manure, and which would have cost nearly as much to remove to a manure pit—which would have been its destination, owing to the wetness of the season—as to make into a lot of healthy, nutritious food, on which we have been partially feeding twenty milch cows, without noticing any ill-effects on their produce, and with ocular demonstration that they relish and thrive on it. About a foot and a half of the sides are bad, as well as a small portion on top."

COL. CLEMENTS' SILO AT LOUGH RYNN DEMESNE, DROMORE, CO. LEITRIM.

The filling of the silo was commenced on Aug. 6, 1883, and consisted of coarse old meadow grass, carted direct from the mowing machine in a *wet* state (the night before having rained heavily), and was forked into the silo by three men; after which it was shaken evenly and tramped by nine men while being put into silo. It was filled to a height of 15ft., and immediately covered with 3in. planks, and weighted in the proportion of 25lb. per superficial foot, by means of a simple lever arrangement, which was found very convenient during the time of filling. In this state it remained for seventeen days, during which time it subsided 7ft., when it was opened, re-filled, and weighted as before. After a lapse of twenty-five days it was found to have sunk 4ft., and when opened about six inches of the top part was partially decomposed and unfit for food. This being removed, the silo was again refilled with a fine description of old meadow grass in a *dry* state, and finally covered with the planks, over which 18in. deep of clay was put, and (with the levers) gave a gross weight of 12½ tons, or 181lb. per superficial foot. During the six weeks following, the mass subsided 6½ft., but since that scarcely anything perceptible. After each filling, a marked descent was observed for the first two or three days.

When the silo was opened in December, the ensilage at first presented a black rotten appearance; but when two inches deep was taken off the top, and about four off the side, the remainder afforded a pleasing prospect. The colour was rather a brownish-green, and the ensilage smelt very strong of malt or brewers' grains, and no difference was observed between the coarse grass which was put in wet at the first filling, and the fine grass put in dry at the last, each being equally well preserved, which convinced those present that the undertaking was a decided success.

The silo was constructed in part of an ordinary farm out-office, by taking off 11ft. at one end by means of a partition. This was formed by three upright beams of timber, the height of the side walls, and 9in. square, placed one at each wall, and one in the centre, which divided the partition into two parts, each 6ft. 3in. wide; two laths 1in. square were nailed on each upright, between which a double sheeting was placed (as the grass was put in), leaving a space of 3in. between, which was tightly packed with sawdust; the sheeting next the ensilage was 1in. thick, and the outside 2in. This compartment measured $14 \times 11 \times 15 = 2310$ cubic feet.

The measurement of ensilage when the silo was opened was $14 \times 11 \times 8\frac{1}{2} = 1309$ cubic feet, and weight 40lb. per cubic foot—equal to 23 tons 8cwt.; this gives a decrease in weight since the grass was put in of 1 ton 2cwt. (24 tons 10cwt. being put into silo). Cost of storing, not including mowing or fitting up of silo, 1*s.* 6*d.* per ton. The number of acres mown was three, the average produce of hay being estimated at 2 tons per acre, equal to 6 tons when stored.

R. C. Roberts,
Agriculturist to Col. H. T. Clements, D.L., J.P.

MR. G. BOLSTER'S SILO, CURRABOWER.

The silo was a house 14ft. long by 8ft. wide, and 9ft. in height. On the 1st of July Mr. Bolster commenced to fill this chamber with long rank grass cut from a lawn overshadowed by trees. The grass was cut into 2in. lengths, and planks were laid and sufficient stones to weigh 100lb. to the square foot. The planks and stones were taken off, and more grass added four times. Mr. Bolster states that he only went to the silo on wet days when he could not carry on the ordinary hay-making operations, and that he invariably put in the layers of grass in a thoroughly wet state, and on the last layer being completed he doubled the weight at first laid on. Thus the silo and its contents remained until Dec. 1st, when the mass was found in a very satisfactory state of preservation. At first the cows partook of it sparingly, but, after a few days, took to it with a keen relish; their milk has increased since they have been fed upon the ensilage, and they look in excellent health.—*Irish Farmers' Gazette.*

ENSILAGE AT THE MUNSTER DAIRY SCHOOL.

The experiment at the Munster Dairy School was of the simplest character, but it has not on that account proved the less successful. The silo consisted of a house, 12ft. by 9ft., which Mr. Smith, the superintendent of the Dairy Farm, got ready by boarding up the window and doorway, the stuff being put over the wall on one side, which is 9ft. 6in. high, and does not reach the roof. The silo was filled between the 1st and 4th of Aug. with 1 ton 14cwt. of vetches, and 4 tons 16cwt. of old meadow grass, freshly cut, and some of which was taken in quite wet. The vetches were passed through the chaff-cutter and put in first around the walls, which are very rough, in order to facilitate sinking. The grass was not cut, but was well tramped as it was put in. When the house was filled, boards were laid on, and on these metal corn stands giving a pressure of 90lb. to the square foot, which had the effect in fifteen days of reducing the mass from 9ft. 6in. to 4ft. 6in. Mr. Smith, however, did not re-fill, as he considered the quantity of stuff put in sufficient for the purposes of his experiment, and in this condition it was allowed to remain until the end of December. The expense of filling, fixing weights, &c., was but 22*s*. When the door was removed the odour coming from the silo was found to be similar to that which proceeds from a brewery vat. The ensilage was of a brownish colour, quite damp and perfectly sweet; quantities of it were at once distributed amongst the cattle in their stalls close by, and they attacked it without hesitation, and with an apparently keen relish. A horse which had been regaling on some dry hay immediately rejected that provender on being presented with a wisp of the ensilage. All present pronounced the experiment an unqualified success, and were highly pleased at the result, notwithstanding that the experiment was of the roughest description. Owing to the roughness of the walls, one or two of the boards got caught at one side; this admitted the air and a small patch, a few handsful of vetches, at this point suffered from rot. The remainder of the vetches, however, notwithstanding that they occupied the most unfavourable position in the silo, turned out perfectly sweet. So satisfied were the committee with this, that they have it in contemplation to next year experiment in a like manner upon grass and mangel tops mixed, mangold tops alone, and other green food.—*The Farmer*.

SIR J. F. DILLON'S ENSILAGE FEEDING EXPERIMENTS.

Sir,—I am stall-feeding twenty-four head of cattle on the contents of a silo erected principally from information obtained from your book. The size is 40ft. by 10ft. by 10ft., and cost just 72*l*., 14*l*. of which was for a travelling winch and box for lifting the weights, 36 tons of stones. I can extend it to double the size for 30*l*. more. I put in Italian rye grass, old meadow grass, oats, beans, and vetches (all uncut), covered with boards 1in. thick, and weighted 200lb. per square foot. I opened it Nov. 26, and

found the corners at the door bad, and about ½in. at the top, bottom, and sides, rather musty, but still eaten by the cattle. On being opened the temperature was 60°. I have the ensilage cut in the morning, shaken up and packed into a heap, enough being cut for that evening and next morning, and find the temperature about 57° when given to the cattle. They get ensilage first in the morning, then cake, about noon a little hay—which they do not care about, although very good—cake again, and ensilage last in the evening; and are doing very well.

Do cattle getting similar feeding to mine drink much water? I find mine very thirsty, no salt having been used. I made no floor, only drained it well, and have no loss at the bottom. JOHN F. DILLON.

Lismullen, Navan, co. Meath, Dec. 17, 1883.

[When ensilage is substituted for roots, cattle will drink much more freely; for, in 100lb. weight of roots there is about nine gallons of water, and in ensilage giving an equal amount of nutriment there would only be about a couple of gallons of water, so the animals must drink to make up the deficiency.—ED.]

SIR,—I send you by post a sample of ensilage from my silo, and shall be obliged if you will give me your opinion on it. I have stall-fed twenty-five heifers on it, with 8lb. of cake per day and 2lb. of hay, and sold them out fat at the end of about nine weeks. I also sold one fat that never got anything but ensilage and 2lb. of hay. These cattle went into the stalls thin, after foot-and-mouth disease, and never had a root of any kind. For about a fortnight at last they got, in place of cake, the same weight of Indian corn or oats. JOHN F. DILLON.

Lismullen, Navan, Meath, Ireland, April 2, 1884.

[The ensilage was of coarse grass, in very moist condition, and unchaffed, and considering the nature of the herbage, was a very good sample.—ED.]

CHEMICO-AGRICULTURAL SOCIETY OF ULSTER.

AT the monthly meeting of this society on Dec. 21, 1883, some particulars were given with respect to a small experiment on the saving of grass in silo. Mr. Walker, whose farm adjoins the school farm, and who has a small silo, put in it on June 30 two loads of upland grass cut and stored on the same day. The grass was well tramped, a little dry straw shaken over the top, then covered with boards and weighted down with field stones; the whole being finished by a light covering of earth to keep out the air. When opened on Dec. 19, the appearance was not enticing, but the grass, although discoloured, was quite sound and without mustiness. When it was first offered to the cows only one ate it, but when given at the usual meal time all ate it with evident relish, and on the following day Mr. Walker said that all his cattle, young and old, ate it as they would fresh grass.—*Irish Farmers' Gazette.*

LORD HARLICH'S SILO, DERRYARNE, CO. ANTRIM.

THE building was a disused ice-house, in form a cylinder of 12ft. in diameter by 14ft. deep, built forty-seven years ago, with brick set in Roman cement. The grass, from an old meadow, much shaded by trees, was evenly spread, and tramped down by five men till the entire structure was filled. Planks were then put on, and weighted with about five tons of rough stones. In nine days the planks, &c., were removed, and the silo filled up with fresh grass, on which some heavy showers of rain fell while carrying. This was repeated at the end of another nine days, when it was filled again with grass that was tedded and remained on the meadow the greater part of a dry day. The planks were finally put on, and covered with a foot of dry sawdust, and weighted with about seven tons of stones, and was left so till Dec. 8. On removing the planks about 3in. of the ensilage was found in a mouldy state. When the first truss was cut out, notwithstanding its yellow colour and potent smell, it was pronounced a complete success, an opinion afterwards fully borne out by the avidity with which both cows and horses consumed the ensilage when placed before them. The herdsman said "he thought they would choke themselves eating it."—*Irish Farmers' Gazette.*

COST OF A SILO IN IRELAND.

SIR,—Having used ensilage with seventy cattle in stalls since the 8th of November, I can add my testimony to that of others as to the advantages of it. I think these cattle have made more progress, for the time, than any others previously fed by me; and consequently I am quite satisfied with the result. But I never depend upon any one kind of food; therefore, I use ensilage in conjunction with others. For the first month, each animal got nearly 3½st. of ensilage per day, with a like quantity of turnips, and about 7lb. of straw. Since then, 3½st. of ensilage, 2st. of turnips, 36lb. of Indian meal stirabout, and a few pounds of straw. I have not heard of a silo constructed exactly as mine is; I therefore give you the details of it.

I cut into a dry gravelly hill, 70ft. in length by 15ft. wide, and 16ft. deep. I bought ten old iron rails, 24ft. long, which raised the structure 4ft. above the surface (being sunk 4ft. into the ground at the bottom of the pit); then I put on wall plates, rafters, and a covering of light boards and felt. In place of walls, I used boards 1½in. thick, filling in the earth, and packing it behind the boards. Finding the pressure of the earth too strong, I added eleven wooden posts, and then tied all (both wood and iron posts) with old cart tyres to short posts sunk in the ground, and not appearing above the surface. The front is built of mason work, with a double door, wide enough to admit a cart.

The silo is divided into five compartments. each 14ft. by 15ft., as it

appeared to me it would be more convenient in that way to fill, and that different qualities of feeding could be kept separate. Three compartments have been filled with first class meadow grass, the remaining two with a very bad kind of marshy grass, to which some salt and spice was added. This will be for the use of newly-bought cattle in spring.

I now give you the cost of the silo, premising that labourers' wages are low in the locality:

	£.	s.	d.
Excavating and removing earth and gravel	15	15	8
Filling in and levelling ditto	1	16	2
Timber	31	12	11
Carriage of ditto	7	1	3
Home-grown timber	2	6	0
Ten old rails	11	7	2
Carriage of ditto	0	4	8
Roofing felt	2	10	0
Felt varnish, 1*l.* 13*s.* 4*d.*; men applying same, 7*s.*	2	0	4
Building stones, and men carting same....................	4	6	6
Lime, 1*l.* 9*s.* 9*d.*; cement, 16*s.*	2	5	9
Mason and attendance	9	14	8
Carpenter and attendance	11	2	0
Blacksmith and attendance..................................	2	7	5
Nails, 6*l.* 17*s.* 3*d.*; bolts and nuts, 19*s.* 6*d.*	7	16	9
143 spikes, 11 iron tires, and 24 straps.....................	1	1	0
Paint for door, and man applying	0	9	4
Gas tar	0	6	2
	£114	3	9

The account is slightly deficient in this, that there was some irregular excavation for gravel already done; but, this having caused some extra trouble in filling, I think 5*l.* would be a fair estimate for it. I did not charge anything for horses, only the men's wages working them.

The silo is constructed square, the corners being merely cut off by a board. The sides of the boards next to the earth have been coated with gas tar, but nothing has been applied to the sides next to the ensilage. The floor is paved, consequently it absorbs all liquid which might otherwise run off by the door, but the ensilage is quite moist, and, without any waste to the bottom; nor was there any worth speaking of on the top, only about four or five hundredweight at the door. I put in five or six tons of thistles, and the cattle eat them as freely as the other ensilage. Not so, however, a second cutting of rye grass and clover; this has a stronger smell, and they are not so fond of it. IRISHMAN.

SIR,—A correspondent in *The Field* of Jan. 5, signing himself "Irishman," gives an account of his experiences with a silo, which, in every particular, even to putting some tons of thistles in the bottom, almost exactly agrees with my own.

I ran an excavation of 60ft. into a gravel bank. Of this, the furthest 18ft. was formed into a silo 14ft. wide and 12ft. deep. The frame was made of larch poles 8in. diameter at small end, and 18ft. long, sawn in

half. These were sunk 2ft. below the level of the floor, and so projected 4ft. above the surface of the surrounding soil. A wall-plate of similar material connected them along each side and end, and stretchers of larch poles notched to drop on the wall-plate completed the frame. This to the surface of surrounding soil was then boarded with 2in. plank of home-grown timber, principally spruce and Scotch fir, fastened on with oak tree-nails. The whole of this timber was prepared by steeping in a solution of lime for about two months, a process which "Irishman" will find a cheap and effective preservation of home-grown timber, both against wet, rat, and the attacks of the little beetle which so speedily destroys sapwood of any kind. The four feet above the permanent planking was filled with movable shutters, to admit of the grass being thrown in from each side as it suited. The filling was done twice. The weights were stones, which were laid down for 1*s*. 6*d*. per ton. Twenty tons was the quantity used for final weighting. The grass was cut from an old meadow much shaded by trees, and which could only be saved as hay by being drawn to another more open field.

We are using about two cubic yards per day, which is drawn to the cattle sheds every morning at ten o'clock, and sprinkled with salt—one feed given at 3 p.m. and one at 7 a.m. next day. The results in the produce of milk and cream are being carefully noted. AQUARIUS.

SILOS IN CO. MEATH.

SIR,—It may interest some of your readers to know what sort of trial the system of ensilage is having in this county. There are several silos in this neighbourhood of various capacities, from eighty to four hundred tons, and all have turned out completely successful.

Beans, vetches, oats, rye grass, and old meadow grass have all been tried without a single failure. In one case over eighty head of cattle have been fed on ensilage for the last six weeks, and are fattening in a remarkable manner. My beasts, though fed with hay aud cake in good aftergrass, will pick up every atom of the coarsest grass ensilage thrown to them.

A correspondent asks for information as to the disposal of grass cut by a lawn mower in silos. Having ensilaged in May last grass of this description under a pressure of 120lb. to the square foot, I am happy to say I have been able to produce a food very palatable to cattle, but not very tempting in appearance, and with a peculiarly acid smell. I presume that, as in the case of comfrey, the very watery nature of the material is the cause of the darkish colour, but, nevertheless, milch cows like it, and give an increased flow of richer milk when fed upon it. There was absolutely no loss in the silo, and all the liquid part had been absorbed. It was somewhat remarkable that in this silo the heating had quite disappeared, and the ensilage when taken out was quite cold.

Randlestown, Navan, co. Meath, Dec. 10, 1883. N. T. EVERARD.

CAPT. McBRIDE'S EXPERIMENTS, CO. CORK.

[At a special meeting of the County Cork Agricultural Society, Capt. McBride laid before the members the following account of his experiments.]

My silo consists of part of a shed built for fattening-stalls. I divided this building with a brick wall, and thus formed a silo 30ft. by 15ft. by 10ft. I left the feeding passage, which runs 4ft. above the bottom of the pit and is 4ft. wide, though I was aware that this must more or less interfere with the making of ensilage. The walls were cemented.

On June 18 I commenced cutting and carting new grass and clover, which was immediately thrown into the pit and trampled by about five men. This went on daily till the 23rd, when the silo was covered with 1½in. boards, and weighted with twenty-one loads of stones, giving a pressure of 77lb. to the square foot. The grass was sometimes wet with rain and sometimes dry. On Sept. 23 I opened the silo and put in more grass and clover (mixed seeds for permanent pasture sown in spring without corn crop), moving boards and stones from one part to another as required, and replacing as quickly as possible.

On Dec. 7 I commenced giving to each of twenty-six milking cows, as her daily ration, 50lb. white turnips, 50lb. cabbage, 10lb. oat straw, and best hay as much as she could consume. The cows were turned out during the day. My cows are numbered, the even numbers standing on the left of the house, the odd on the right.

On Dec. 14 I opened the silo and found the contents good, except some inches on the top and sides, which were mouldy and unfit for use. Some was also bad at bottom angle of feeding passage. The September ensilage was not so good, however, as that made in June. The grass and clover were not so good when put in, and the boards and weights were, in my opinion, put on too quickly, thus preventing the escape of air. Some of the cows at first refused to eat this, but in a few days ate any part of the ensilage greedily.

On Dec. 14 I weighed the milk of the cows, and tested it for butter fat on 12th and 14th. The result was that the fifteen cows with odd numbers gave 207lb. milk (average, 13·8); the eleven with even numbers gave 153lb. milk (average 13·9).

On Dec. 12 the evening's milk of odd numbers gave 2·56 per cent. butter fat; and on the 14th their morning's milk gave 2·77 per cent. (average, 2·66). On Dec. 12 the evening's milk of even numbers gave 2·26 per cent. butter fat; and on the 14th their morning's 2·46 per cent. (average, 2·36). Showing that the odd numbers gave less than the even, but that their milk was of better quality.

I now instructed my steward to feed the odd numbers as before, but to give even numbers 20lb. ensilage and only half former supply of roots and cabbage, straw as before and no hay, and to increase ensilage daily and reduce green food gradually till Dec. 21. For the first two or three

days the cows got more ensilage than I intended, but on the whole I believe the experiment to have been fairly carried out.

On Dec. 21 I weighed the milk, and tested it for butter fat on the 19th and 21st. The result was that fifteen odd numbers gave 214lb. milk (average, 14·26); eleven even numbers gave 161lb. milk (average, 14·63). On Dec. 19, evening's milk of odd numbers gave 2·36 per cent. butter fat, and on the 21st their morning's milk gave 2·66 per cent. (average, 2·51). On Dec. 19, evening's milk of even numbers gave 2·56 per cent. butter fat, and on the 21st their morning's milk gave 2·87 per cent. (average, 2·71). Showing that odd numbers gave still less milk than even, and that even numbers gave richer milk than odd instead of poorer, as they did before getting ensilage. Of the fifteen odd numbers (getting no ensilage) five decreased in quantity, seven increased, three gave same amount as preceding week. Of the eleven even numbers (getting ensilage) one decreased in quantity, six increased, four gave same amount as preceding week.

From Dec. 21 to 28 each cow got half a cubic foot (about 20lb.) of ensilage, 50lb. green food, 8lb. oat straw. On the 28th the milk gave an average per cow of 13·18lb. Three cows were allowed to go dry, but in the above calculation they are included as having given the same quantity as preceding week. The evening's milk of Dec. 29 gave 2·56 per cent. butter fat; the morning's milk of Dec. 31 gave 2·77 per cent. butter fat (average, 2·66). Showing that for feeding purposes half a cubic foot of ensilage (or 20lb.) is equal to 50lb. of roots and cabbage, 2lb. of straw, and 10lb. of hay; for, by giving this amount of ensilage, I save all the hay, half the roots, and 2lb. of straw per day for each cow, and yet get as much milk as before (allowing for the natural decrease at this time of year), and that of a better quality than on Dec. 14, when the cows had been fed on 100lb. green food, 10lb. of straw, and hay as much as they could eat. This hay I estimate at 10lb. The cows were each getting from 2lb. to 3lb. undecorticated cotton cake daily during these experiments.

Glendonagh, Midleton, Jan. 3, 1884. E. E. McBride.

SILOS IN KING'S COUNTY.

Mr. W. P. H. Lloyd-Vaughan, D.L., of Golden Grove, constructed last spring two silos, each 16ft. long, 6ft. wide, and 8ft. high. A cowhouse, the roof and outside walls of which were in good repair, was used for the purpose, and divided by a partition built of concrete 9in. thick. On the 11th of July Mr. Vaughan commenced to fill the silos with wet grass, cut during heavy rain. On the first day 3ft. of grass was put in, and on the two succeeding days 18in. When the silos were filled, boards 1¼in. thick, and a little short of the breadth of the silos were placed across the top, and on these boards weight to the amount of 112lb. to the

square foot. After three days more grass was added to the mass, and on the sixth day the same operation was repeated. There was then placed a covering of 3in. of heather, and on this the boards and weights, the latter being increased to 2cwt. to the square foot. In about a month, the fodder having sunk 2ft., it was filled with an additional quantity as before. The silos were then left until the close of November, when they were opened. The ensilage was in a very perfect state, moist, but no water could be squeezed from it. At the extreme top of the silos it was not as good as the middle or bottom of the pit. Mr. Vaughan gave three stone of the ensilage per day to four of his milch cows. They ate it greedily and appeared to thrive on it, and gave more milk than before. The quantity of grass siloed was 30 tons, 15 tons in each silo.

The result, highly satisfactory as it is, did not in any way surpass in success that of a similar experiment made at the farmyard of Charleville Forrest, Tullamore, by Mr. Lammon, steward to Capt. Kenneth Howard, D.L. This silo, which was opened on Dec. 3, was constructed entirely above ground, an existing building being used for the purpose. The pit was filled with coarse wood grass, green oats, and vetches. It could scarcely be anticipated that this material, which could not ordinarily be turned to any profitable account, would make good ensilage; yet the experiment, carried out under difficulties likely to militate against success, was pronounced a signal success. The preservation of all the ensilage was perfect, and on a portion of it being given to a cow that had never previously tasted such food, it was at once eaten with apparent relish. Capt. Kenneth Howard meditates erecting extensive and permanent silos during the ensuing year, to be worked under the supervision of his steward.—*Irish Times.*

ALBERT MODEL FARM, GLASNEVIN.

[Professor Carroll, in accordance with the desire of the Lord Lieutenant of Ireland (Earl Spencer), carried out some ensilage experiments in 1882 on the model farm of the Albert institution, and at the beginning of 1883 his official report was issued, from which the following are extracts.]

I am of opinion that the successes of the Continental and American farmers are sufficient to warrant our trying it on an extensive scale in these countries, and the measure of success of our experiments at the Albert Farm strengthens my opinion on this point.

Referring to the opinions adverse to its adoption here, I would suggest, First, as regards our cultivated plants not being suited for ensilage. There can be no doubt that grasses of various kinds are well adapted to the process, and on a large range of soils—especially peat—Italian rye-grass yields a large produce. Rye, too—a crop which may be profitably cultivated on our poor, cold soils—is well suited to the system. I believe

that many of the indigenous grasses—notably fiorin (Agrostis stolonifera)—will be found to yield a large quantity of suitable fodder, and that if the system were adopted much green fodder now lost would find its way into the silo, to be profitably consumed by cattle. Doubtless, too, we should find that if the silo became an institution a large introduction of forage plants would take place—many varieties of the sorghum being particularly suited to the system—and more attention might also be given to the cultivation of maize in the districts suited by climate for its growth.

Again, it may be found by future experiment that the costly system of root-growing may give way before a less expensive system of growing other provender for ensilage, and that the produce of grass or other ensilaged fodders may exceed in nutritive matter a much heavier crop of roots. These are matters for future experiment, to be carried out under the direction of practical and scientific men.

Respecting the opinion that the chemical changes which take place during the slight fermentation of the fodder are injurious to it as food, I cannot help thinking that this opinion has been arrived at in too summary a manner.

I may say that I consider the matter has the largest interest for the dairy farmer, foreign experience having shown that ensilage has increased the yield of milk in dairy cows very considerably, and that the objectionable flavouring of milk and butter which results from the consumption of roots is avoided where ensilage is substituted.

[The information as to the *modus operandi*, given below, is not so complete as is desirable. There is nothing to show what, if any, weight was put on the fodder; yet it is difficult to see how the silo could otherwise be made air-tight. The experiments were as follows:]

On the 25th of July the fodder was cut.

No. 1. Lucerne and straw chaffed and put into a silo about five feet deep, and lined with boards, so as to make it air-tight and water-tight.

2. Comfrey and lucerne chaffed, with a very small proportion of oat straw, and put into a similar silo.

3. Italian rye-grass, not chaffed, packed tightly into a silo.

4. Italian rye-grass, not chaffed, packed tightly into a silo which was simply a pit dug in the ground, without any protecting casing or lining.

5. Italian rye-grass, packed tightly on the surface of the ground, and covered with about eighteen inches of earth in a manner similar to a "potato pit."

On the 9th of October the silos were opened, and the following was the result:

In numbers 1, 3, and 4 the fodder had a temperature of about 75° Fahr.; it was apparently in good condition, having a smell somewhat like fresh brewers' grains. The cows on pasture, as well as those which were being house-fed, ate this food with avidity.

In number 2 the comfrey and lucerne were quite spoiled; the colou

had not been much altered, but the smell was most offensive, and the mass appeared to be quite putrid.

No. 5, the Italian rye-grass, was quite dry, but mouldy, and perfectly unfit for food.

[The particulars of the analysis are not so clear as could be wished, the two specimens of ensilage not being identified with the experiments to which they belong. Thus, ensilage No. 1 and No. 2 cannot have come from silos No. 1 and 2, and would appear to be samples of the Italian rye-grass from silos 3 and 4. The difference between them as regards water and other constitnents probably arises from the one having been kept in a water-tight silo, and the other in an unlined hole dug in the ground, but there is no evidence to show which is which. Dr. Cameron says :]

The specimens of ensilage were in a state of fermentation when they were brought for analysis. The specimens were at once subjected to a temperature of 212°, and kept thereat till dried, which prevented further fermentation.

It is noticeable, first, that the albumenoids are less in the ensilage than in the original grass; that the water is much the same in quantity in all the samples; that the amount of soluble non-nitrogenous matter is greater in the ensilage than in the grass from which they had been prepared; that the amount of ash is greater in the ensilage than in the grass.

Composition of Ensilage and of the Grass from which it was made.

100 parts contain—	Grass when cut.	Ensilage No. 1.	Ensilage No. 2.
Water	68·20	66·50	68·10
Albumenoids (nitrogenous substances)	2·83	2·76	2·60
Non-nitrogenous substances, soluble in acids and alkaline solutions	13·42	15·20	14·82
Insoluble in ditto	11·73	11·37	10·13
Fats	0·76	0·77	0·75
Mineral matter (ash)	3·06	3·40	3·60
	100·00	100·00	100·00

[As it may interest some of our readers to compare these analyses with those which appear in other pages, we have recalculated the percentage on the *dry substance* only, when the variation in the solid matter will be more readily seen than when the differing quantities of water are included.]

100 parts of dry substance contain—	Grass when cut.	Ensilage No. 1.	Ensilage No. 2.
Albumenoids	8·90	8·24	8·15
Non-nitrogenous substances :			
Soluble	42·20	45·37	46·46
Insoluble	36·89	33·94	31·76
Fats	2·39	2·30	2·35
Ash	9·62	10·15	11·28

FERMENTATION IN SILOS.

[Mr. George Fry, F.L.S., of The Warren, Chobham, Surrey, has given in the *Agricultural Gazette* and in the *Farmers' Almanac* some interesting particulars with respect to the temperatures in his silos, and we combine several letters so as to make the information consecutive, but omit some of the less important portions, in order to save space.]

My first experiment with ensilage was made in 1882. I grew a few rods of maize stems on some headlands. I then dug a hole in the ground in a dry sandy hillside. It was about 6ft. by 12ft. by 8ft. deep, I cut the maize stems just as they were blooming, cut them into chaff about half an inch long, and threw it into the hole, covered the ensilage with planks 2in. thick, and filled up the hole with sand. After three months I threw out the sand and found sour ensilage perfectly sound and good. I fed my milch cows entirely on it for a fortnight, and found it increased the milk about 25 per cent.

This year (1883) I filled two similar holes of the same size, 6ft. by 12ft. by 8ft. deep, with chaffed green rye, covering with 2in. planks and sand as before. When they had been covered for about four months I opened them, and found sour ensilage perfectly sound and good. I fed it to cattle and sheep with good results. There were at least 20 tons of this rye ensilage.

In the meantime I had built three silos in concrete, each 12ft. by 12ft. by 15ft. deep. They have solid walls, 9in. thick, of Portland cement concrete, and the bottoms are of the same material; 9ft. 6in. of the walls are above ground, and 5ft. 6in. under ground. On the front side each silo has a door of red fir 2in. in thickness, which is closed and made secure before the filling of the silo is commenced. The silos are filled from the top.

The green crop was mown, carried at once from the field, and pitched from the cart into the silo, spread as evenly as possible, and well trodden, especially round the edges. The silo was not filled up at once, but a fresh layer of fodder about 2ft. thick put in every day (as recommended by M. Goffart). When the ensilage began to reach the top of the silo, the mass sank considerably in twenty-four hours, so that complete filling was a work of some days. The filling of No. 1 silo was commenced on June 7, 1883, with Trifolium incarnatum, of which about 15 tons were put in; then about 3 tons of rough grass, then another ton of trifolium, filling up with clover and rye-grass. On June 30 the silo was full.

By means of a perforated iron tube with a sharp steel point, driven into the centre of the mass, I ascertained the temperature to be on June 30, at 2ft. from the top surface, $31\frac{1}{2}^\circ$ C. (89° Fahr.); at 3ft., $43\frac{1}{2}^\circ$ C. (110° Fahr.); at 4ft., 46° C. (115° Fahr.); at 5ft., 53° C. (128° Fahr.); at 6ft., 56° C. (133° Fahr.)

This silo was then covered with paper, and with 2in. planks laid closely together, sand being thrown on to the planks to the depth of about 12in.

On July 11 the mass had sunk about 6ft.; it was therefore uncovered, and the temperature at 6ft. from the surface found to be 60° C. (140° Fahr.) The silo was filled up with meadow grass, covered, and weighted as before. The operation of uncovering and filling up with meadow grass was repeated on July 17, and this silo was finally closed and weighted with 2ft. of sand on July 21, when I ascertained the temperature at 6ft. from the surface to be still 60° C.

The filling of No. 2 silo was commenced on June 30 with clover and rye-grass, and proceeded somewhat more rapidly than that of No. 1. When the height reached was 9ft. from the bottom, I ascertained the temperature at 6ft. from the surface to be 36° C. (97° Fahr.) After this meadow grass of good quality was put into this silo. On July 7 the temperature at 6ft. from the surface had risen to 65° C. (149° Fahr.) On July 11 this silo was full, and was covered up and weighted. On July 14 it was again uncovered (having sunk fully 6ft.), and the temperature then at 6ft. from the surface was 70° C. (158° Fahr.)

From these observations it will be evident that the temperature in the interior of these silos was maiutained for a very considerable period at from 60° C. to 70° C. (from 140° to 158° Fahr.) The escape of heat from so dense a mass is very slow. On July 1 the temperature of the sand covering No. 1 silo was 20° C. (68° Fahr.), and on July 7 it had risen only to 30° C. (86° Fahr.)

Silo No. 1 was opened on Oct. 25, after having been closed four months, and its contents were found to be precisely similar to a sample taken immediately before the final weighting. But this ensilage differs entirely in character from the results of my previous experiments (made with chaffed green maize stems, and chaffed green rye). I have already (Nov. 27) used about 20 tons of the ensilage for sheep and cattle. It is excellent fodder, and the animals thrive well on it. This is brown sweet ensilage.

The other two silos have not yet been opened, but I know from the temperature that the second silo will be a brown sweet ensilage, and the third (whole green maize stems) will be sour ensilage.

This year (1883) I have about 120 tons of ensilage, and next year I intend to have at least 150 tons.

My neighbour, Mr. E. J. Halsey, of Pirbright, has built two silos 12ft. by 12ft. by 12ft. deep. He has filled one partly with green rye and partly with trifolium. His experiment has been perfectly successful; his ensilage is of the sour type, but of excellent quality.

It is quite clear from my own observations, and also from statements which have been published, that so high a temperature as 50° C. (122° Fahr.) is by no means general; the maximum temperature in silos apparently ranging from 20° C. (68° Fahr.), to 70° C. (158° Fahr.) according to the nature of the crop and the conditions under which it is stored.

It appears to me quite evident that there are *two distinct types of ensilage,* either of which may be produced at will. This fact explains the

very different opinions which have been expressed as to this mode of preserving green crops, and also the very material variations in the analyses which have been published. In order that the difference in these two types of ensilage, and the conditions necessary to produce them may be understood, it will be necessary to consider briefly the laws which govern fermentations of the class to which those of the silo belong.

To Gay Lussac we owe the discovery of the first two laws (which have since been confirmed by M. L. Pasteur, and, as far as I know, have received general acceptance):—(1) Free oxygen is a necessary agent at the commencement of fermentation; (2) When fermentation has become active, a supply of free oxygen is no longer necessary to its progress.

Oxygen exists among the green plants packed in a silo, consequently some kind of fermentation is always set up. This fact I have ascertained by direct experiment, and it is confirmed by all the analyses of ensilage which have been published, for they show the presence of considerable quantities of organic acids, products of fermentation. In accordance with law 2, the fermentation once begun would continue indefinitely even in an airtight silo.

Pasteur discovered another law. (3) Active fermentation continues, in accordance with law 2, only within certain limits of temperature. A temperature exceeding 50° C. (122° Fahr.) destroys the vitality of ferments, and the germs remain inert until again excited by free oxygen. The kind of fermentation to which grasses and clover are most readily subject when exposed to the air is that commonly known as "haying." Its progress is sufficiently indicated by the sweet, aromatic odour which is characteristic of its products. The temperature in the interior of a rick of well-got meadow hay reaches (in my experience) a maximum between 60° and 70° C. (140° and 158° Fahr.) But if similar green crops be protected from the atmosphere, "haying" does not take place; they appear under these conditions most readily to undergo lactic fermentation, which is indicated by a sour and rather repulsive odour. The temperature most favourable for this fermentation lies between 20° C. and 40° C. (68° and 104° Fahr.)—45° C. (113° Fahr.) appearing to be the extreme limit.

Now, if grass or clover be mown and thrown into a silo in small quantities daily, so that considerable exposure to the atmosphere is allowed (as, for instance, in the case I have before cited, where a silo 12ft. by 12ft. by 15ft. deep was filled gradually in a period extending over several weeks), a brisk "haying" fermentation will be excited. The temperature rises rapidly until it exceeds 50° C. (reaching in the one case cited 60° C., and in the other 70° C.)

This temperature (in accordance with law 3) arrests and destroys the vitality of the ferment. Consequently, if the silo be maintained perfectly air-tight (the smallest crevice does considerable damage), the ensilage will be preserved without apparent change from the condition in which it was when finally covered up and weighted.

The ensilage produced by this process is of a brown colour, and of a sweet, luscious odour, free from acidity, very much resembling that of ordinary hay. Practical farmers say it smells like "mow-burnt" hay. It is very compact and dense, a cubic foot weighing from 45lb. to 50lb. Cattle, sheep, aud horses eat it at once with apparent relish. It is difficult to conceive how ensilage of this type can differ very widely in feeding properties from ordinary hay. One would also suppose that its exposure for months to a high temperature would render it easily digestible. It seems to me that it will be convenient to distinguish this type as *brown ensilage*.

On the other hand, if a silo be filled with chaff, green rye, or green maize stems, or with clover or meadow-grass in such a manner as to prevent the access of the atmosphere—for instance, if it be filled as rapidly as possible, well trodden, and covered every night so as to exclude the air, then ensilage of a totally different character will be produced. The temperature will rise only slightly, probably never exceeding 20° C. (68° Fahr.) On opening the silo, after having been closed for several months, the ensilage will be found to be of a pale greenish-yellow colour, and the flowers of trifolium incarnatum will still retain a dull purple hue. It will have the peculiar acid smell (very persistent and not very agreeable) characteristic of vegetable substances which have undergone lactic fermentation (resembling the "sauerkraut" of the Germans). It will be convenient to designate this type as *sour ensilage*.

On entering silos containing sour ensilage of chaffed green rye a very strong odour of aldehyde is observable—a substance which does not appear in this case to have been formed by the oxidation of alcohol (for I have as yet seen no indications of alcoholic fermentation in silos). It is probably either formed from the decomposition of lactic acid or is a bye-product during the fermentation. If such ensilage be exposed to the air, the smell of aldehyde soon disappears, and a new fermentation begins, with a rise of temperature, and the production of a slightly vinous odour. Although to human beings this kind of ensilage may be to some extent repulsive, animals seem to have considerable predilection for it; they eat it readily and thrive well on it. A cubic foot of sour ensilage weighs generally somewhat less than the same volume of the other type.

Brown ensilage can be easily produced from trifolium incarnatum, from clover and rye-grass, and from meadow-grass, but I have not yet obtained it from green maize nor from green rye.

Sour ensilage can be produced from any green crop. Both the kinds of ensilage which I have described appear to me to be sound and wholesome food (I have used many tons of both kinds). I am unable to say which sort is preferable. Perhaps sour ensilage will be found most suitable for animals producing milk, and brown ensilage for fatting stock.

I can only hope that the publication of my remarks on this interesting subject may induce agriculturists who are experimenting to ascertain and to record the temperature of their silos (at not less than 4ft. from the

surface), as well as the type to which their ensilage belongs, in order that before long we may make some well-defined principles to guide us in obtaining the best possible result from the preservation of our green crops as ensilage. . . .

Sir J. B. Lawes endorses the statement of Professor Brown that "no one had yet been able to produce untainted fodder by this method," &c. If this be the case in America, it is not so here! To those of your readers who have followed my remarks with attention it will be evident that "sour" ensilage must always contain the products of the lower forms of fermentation, to a greater or less degree, and therefore may be said to be tainted. Consequently, it has happened, in my own experience, and also in that of some of my correspondents, that, when this kind of ensilage has been given to cows, a disagreeable flavour has been imparted to the milk, cream, or butter. But this is by no means generally the case. One of my neighbours has given "sour" ensilage to his cows during the whole of the past winter, and he tells me that his dairy products have been in every way excellent. From the conditions under which Mr. Henry Woods, of Merton, prepares his ensilage, I know that it is of the "sour" type; but we know from his published experience that the dairy products at Merton have been free from taint or disagreeable flavour. A mass of other evidence has also been published to the same effect. Therefore I think that even with "sour" ensilage the sweeping assertion of Professor Brown should be taken only in a modified sense.

But in the case of "brown" ensilage, I have succeeded in producing it absolutely free from taint. I have just received (April 7, 1884) from Dr. Voelcker the following results of the analysis of two samples of ensilage—No. 1 from clover and rye-grass, and No. 2 from meadow-grass:—

	No. 1.	No. 2.
Water	75·80	74·40
*Albuminous compounds	2·53	2·56
Crude Fibre	18·31	17·90
Extractive matter	1·42	2·99
Mineral matter (ash)	1·94	2·15
	100·00	100·00
*Containing nitrogen	·406	·414
Acidity (reckoned as acetic acid)	·027	·073

I am aware that a short analysis like this conveys little information on the general question of the feeding value of the ensilage, but the exceptionally small amount of acidity conveys, as I think, a complete answer to the question of taint.

Moreover I sent similar samples of ensilage to my friends, Messrs.

C. F. Cross and E. J. Bevan, and asked for information on specific points, to which I have received the following replies:—"Neither ensilage contains soluble aromatic bodies (tannins)." "No furfurol present." "Acetaldehyde could not be detected."

In the above analyses "crude fibre" includes other substances besides insoluble cellulose. This substance (cellulose) forms (as I learn from Messrs. Cross and Bevan) in the case of No. 1, 30·90 per cent. of the entire dry substance, and in the case of No. 2, 34·15 per cent. In the one case, therefore, the crude fibre (18·31) would contain about 7·47 of cellulose, and in the other 17·90 of crude fibre would include about 8·74 of cellulose. The mineral matter (ash) of course includes the common salt added at the time of pitting.

The crops (and their conditions), with which I have been most successful have been meadow-grass and clover and rye-grass. These crops mature in June and July; and, consequently, in ordinary seasons do not contain so large a percentage of moisture as the crops which are ready to cut in May or early June. The proportion of water in the crop should not be so great that any portion of it should be expressed when moderate pressure is applied in the silo; and I think that it should not be more than 75 per cent., nor less than 50 per cent. A crop of good meadow-grass, in full bloom and fit to cut for hay, in the middle of a warm, bright July day, appears to me to be the standard of perfection. As to green rye and Trifolium incarnatum (both cut in May), it seems to me probable that they may require slight drying before ensiling (at any rate when beginning to fill a silo), as I will hereafter explain.

When the plant is in full bloom is no doubt the best time to cut in all cases. As to maize, the large flat (horse-tooth) maize appears to me the best kind to sow. Great care must be exercised in the choice of seed, for its germinating power is apt to be very low, owing mainly I suppose, to heating during its long journey. But the difficulty I have found with this plant is to protect it in its early stage from the ravages of the birds. When the young shoot has appeared aboveground, rooks and other birds dig up the plant, in order to obtain the soft, sweet seed at the root. In this way I have seen thousands of my maize plants destroyed in a day, I do not recommend the cultivation of maize as an ensilage crop.

Ensiling, or filling the silo, is the crucial operation of the whole business. It will always require judgment and intelligence, and at present we have little experience to guide us. We must try to keep certain well-defined principles in view, and gradually perfect our practice by exact and careful observation.

A brisk fermentation must raise the temperature of the whole of the contents of the silo above 50° C. (122° Fahr.). As the silo is an air-tight chamber, we need have no fear of the temperature rising too high, because, as I have shown, as soon as the temperature exceeds 50° C. (122° Fahr.) it begins to destroy the vitality of the ferment. The temperature acts, therefore, as an automatic governor of the fermentation.

The temperature may exceed even 70° C. (158° Fahr.) without doing the least harm. As heat ascends, if we are careful to obtain the necessary heat at the bottom of the silo, we need have no fear of the top. Air must be present among the fodder in sufficient quantity to excite this necessary brisk fermentation. If we fill the silo too quickly, or if we chaff the fodder, the air will be forced out of the lower layers by the weight of the superincumbent mass, and we shall have either all sour ensilage, or sour ensilage at the bottom of the ensilage, and a good brown ensilage at the top. If the fodder contain too much water it will rapidly fall together in a cold sodden mass.

It will now be seen how difficult it is to fulfil these necessary conditions with the thick, hard stems of maize. If we put them in whole, the air has little action on them (on account of their large size and hard cuticle), the temperature will gradually rise to about 20° C. (68° Fahr.), and then it will begin to fall—we shall have a disagreeable mass of sour ensilage. If, on the other hand, we chaff the maize, it falls together very quickly and produces very good sour ensilage; but I have not succeeded in obtaining the necessary heat to produce brown ensilage. M. Goffart insists on the advantage of filling small quantities of chaffed maize at a time, but whether he really succeeded in obtaining the desired temperature has not been recorded. It is clear that he knew that a brisk fermentation was an advantage, but he did not know why.

Filling the Silo.

With these principles in view the following is the precise method I propose to adopt in filling a silo :—

Mow about a couple of cartloads of grass, and half-make it into hay. As soon as it develops the characteristic smell of hay (before it is dry) cart it to the silo and spread it lightly over the bottom. On to this at once put about two feet deep of the fodder to be ensiled, mown and carried direct from the field. Do not trample it, but spread it even and lightly. The next day add another 2ft. of fodder, mown, carried, and put in in the same way. Proceed in this way for a few days until the surface of the mass has risen more than 6ft. from the bottom of the silo. Now drive into the mass the iron tube (which I will hereafter describe), and with the thermometer ascertain the temperature at a foot or two from the bottom of the silo. If this reaches 45° C. (or 113° F.) you may proceed more rapidly and fill up the silo in one, two, or more days, treading it round the sides so as to insure the even settling of the fodder near the walls. If the temperature at the bottom is found to be below 45° C., the top layer of fodder must be shaken up, and the filling continued gradually, the fodder being put in as lightly as possible. When the temperature increases to 45° C., the silo may be filled up more quickly. As the sinking of the mass makes room at the top of the silo, fill up with more fodder every day or two. If Sunday or a very wet day intervene at any stage of the operations, so as to stop the work, it will be of no con-

sequence; but the interval between leaving off filling and beginning again should not exceed four clear days. It will be better to shake up an inch or two of the surface before adding fresh fodder.

Neither covering nor weighting is to be put on during the progress of the filling (of course rain is to be kept out). When the mass sinks so slowly as to leave little space for fresh fodder after an interval of two or three days, the silo may be filled up with fodder, well trodden, so as to get in as much as possible, and finally covered up and weighted. In a week or two the mass will sink probably about one-fourth of the total depth. If a temporary top has been added to the silo, this may then be removed.

If desired, the covering may be removed, and the silo again filled up; but I consider it preferable to have sufficient silo-room, that the necessity for this may be avoided. The labour is considerable, and a layer of taint will always be found where the covering has been. As will have been observed, the speed with which the silo can be filled will depend much upon the condition of the crop. If it be succulent and watery, the filling must proceed slowly (at any rate at the commencement), and the fodder must be spread lightly. If the crop be ripe and dry, the filling may proceed rapidly, and the fodder be trodden in.

From time to time the testing tube should be driven in; whenever a temperature of 45° C. (113° F.) is shown at 3 or 4 feet from the surface, the filling may go on rapidly. In some cases (especially when beginning to fill a silo), when the crop is green and succulent, it may be found desirable to dry the fodder in the sun for a few hours, in order to avoid the introduction of too large a percentage of moisture.

The testing tube I have constructed in the following manner:—A piece of common iron gas pipe, 1in. in diameter (internal) and about 6ft. long, is shod at one end with a solid steel point, and just above this a few holes about one-eighth of an inch in diameter are drilled, so that air or gas may pass in within a foot of the point. On to the other end a ferrule, to which two strong arms have been welded, is screwed. This tube is driven into the ensilage with a wooden mallet, and is withdrawn by means of a chain wound round the ferrule. As the ensilage holds the tube very tightly it will be found necessary to use a wooden lever attached to the chain to withdraw it; it can also be twisted by means of the arms to loosen it.

When the tube has been in its place for ten minutes or more (the top being plugged) the temperature may be observed by dropping down inside it an ordinary glass thermometer attached to a string, and after a few seconds rapidly pulling it up. These thermometers may be obtained graduated either to Centigrade or Fahrenheit scale. I prefer the former.

A small piece of wool or other similar substance should be pushed down to the bottom of the iron tube in order that the glass thermometer, when let down, may not be broken by coming in contact with the iron.

INDEX TO SILOS.

[The following does not profess to be a complete list of those who have had silos constructed in Great Britain and Ireland; but, inasmuch as many silos were known to be in existence in the United Kingdom besides such as are particularised in the foregoing pages, it was thought probable that it might be of interest to the reader to have the Index to this volume supplemented by the names of owners of silos not included therein, even though there may be no further particulars.

Where figures are given, they refer to the pages of this book. Where the letters R.A.S. are inserted, they indicate that particulars will be found in the "Journal of the Royal Agricultural Society of England" for April, 1884; and B. & W.E., in like manner, indicate the "Journal of the Bath and West of England Society" for February 1884. Where neither figures nor letters are given, it means that those who are named are owners of silos, but that further information about them is wanting.]

There are doubtless many other silos in existence of which we have no particulars; and certainly many more will be constructed in the course of the present year. We shall be glad to receive the names of any owners of silos not in this list.

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